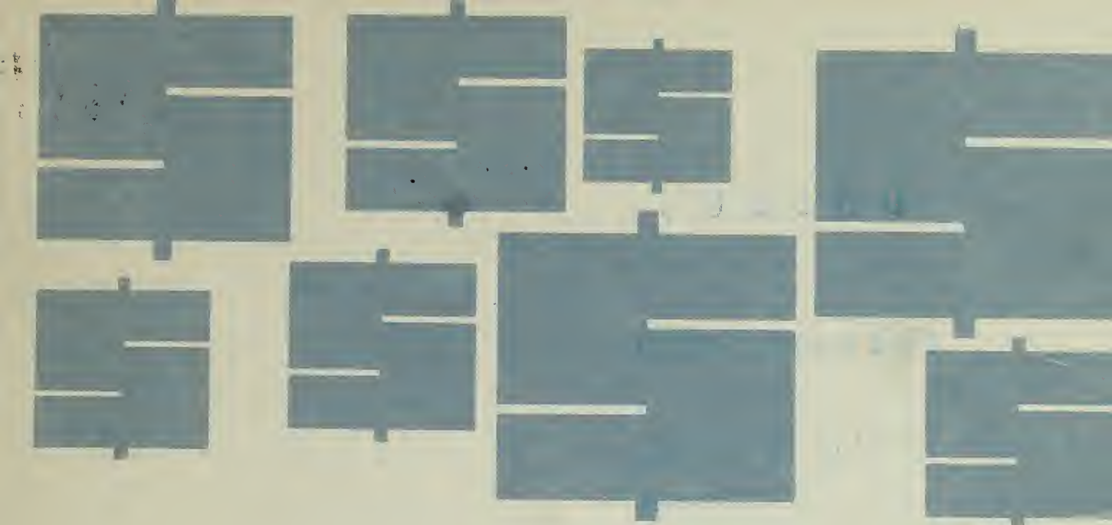

Compendium of Tax Research 1987

Office of Tax Analysis
Department of the Treasury • Washington, D.C. 20220

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PREFACE

In the development of tax policy for the Executive Branch of the U.S. Government. the staff of the Office of Tax Analysis (OTA) engages in sophisticated economic research in order to address present and anticipated policy issues. In the case of fundamental tax reform. many policy questions could not be answered by the existing literature; the OTA staff had to develop new models. incorporate more realistic assumptions. and use more comprehensive data than were available elsewhere. The resulting analyses provided more than sufficient material for a compendium volume, and the publication of some of those analyses here help to make such research more widely available. We believe the studies included in this Compendium demonstrate the breadth. depth, and quality that exemplifies the work of the OTA staff.

A number of acknowledgments are in order. First, it was Don Fullerton. former Deputy Assistant Secretary (Tax Analysis), who stressed the advantage of more widely disseminating staff analyses and organized the development of these papers into a single volume. Second, Assistant Secretary J. Roger Mentz strongly supported completion of the Compendium and emphasized its longer-term benefits to the office. Third. Rudie Slaughter was of invaluable assistance to the editors, Don Fullerton and Tom Neubig, in preparing the final manuscript as a single, unified. volume. Finally. the members of the Office of Tax Analysis staff deserve special recognition not simply for the models and studies presented here - which represent only a small portion of their total efforts on behalf of the public they serve - but for the innumerable analyses, testimonies, and briefings that help guide tax policy and, in a most recent case, were crucial to to the development of the Tax Reform Act of 1986.

Finally, it must be stressed that any views expressed in these studies are those of the authors and do not necessarily represent the views of the Treasury Department.

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CONTENTS

Introduction Don Fullerton 1

1. **A Guide to Interpreting the Dynamic Elements of Revenue Estimates** 13
Howard W. Nester

2. **The Treasury Individual Income Tax Simulation Model** 43
James M. Cilke and Roy A. Wyscarver

3. **Family Economic Income and Other Income Concepts Used in Analyzing Tax Reform** 77
Susan C. Nelson

4. **Tabulations from the Treasury Tax Reform Data Base** 101
James R. Nunns

5. **Investment Incentives Under the Tax Reform Act of 1986** 131
Don Fullerton, Robert Gillette, and James Mackie

6. **Investment Allocation and Growth Under the Tax Reform Act of 1986** 173
Don Fullerton, Yolanda K. Henderson, and James Mackie

7. **The Treasury Depreciation Model** 203
Geraldine Gerardi, Hudson Milner, Leslie Whitaker, and Roy Wyscarver

8. **The Impact of the Tax Reform Act of 1986 on Trade and Capital Flows** 229
Harry Grubert and John Mutti

9. **Impact of the Corporate Alternative Minimum Tax: A Monte Carlo Simulation Study** 253
Lowell Dworin

10. **The Impact of the Tax Reform Act of 1986 on Commercial Banks** 279
Thomas S. Neubig and Martin A. Sullivan

11. **The Use and Abuse of Rental Project Models** 307
Leonard E. Burman, Thomas S. Neubig, and D. Gordon Wilson

LIST OF TABLES AND FIGURES

Tables **Page**

Howard W. Nester

1.1 Revenue Estimates - Tax Reform Act of 1986 27

James M. Cilke and Roy A. Wyscarver

2.1 Essential Attributes Preserved in Reducing the 1981 SOI File 47
2.2 Targets for Extrapolated 1983 Tax Model 50
2.3 Items Recalculated by the Tax Calculator 61
2.4 Tax Model Tabulations for Analysis by Output Table Number 63
2.5 Average Marginal Tax Rates on Selected Income Sources Under 1980 Law, Current Law, and the Tax Reform Act of 1986 66
2.6 Distribution of Tax Change and Number of Families Affected by Economic Income for Families 69

Susan C. Nelson

3.1 Comparison of Personal Income and Family Economic Income, 1983 81
3.2 Derivation of Family Economic Income from AGI, 1983 83
3.3 Distributional Comparisons of Corporate and Family Economic Income, and Individual and Corporate Income Tax Liabilities 88
3.4 Derivation of Modified Expanded Income from AGI, 1983 91
3.5 Derivation of "Economic Income" From Modified Expanded Income 92
3.6 Age Distribution of Dependent Filers, 1983 94
3.7 Distribution of Returns and Families, Filers and Nonfilers, Under Alternative Income Classifiers 94
3.8 Distribution of Tax Units Age 16+ By Modified Expanded Income, Families By Modified Expanded Income and By Economic Income 95
3.9 Individual Tax Liabilities Under 1988 Law, Before and After the Tax Reform Act of 1986, By Economic Income of Families, Modified Expanded Income of Returns Age 16 and Over, and AGI of Returns 96

James R. Nunns

4.1A All Returns: Gross Income, Adjustments, Deductions, Exemptions, Taxable Income, and Taxes Under 1983 and 1988 Law 104
4.1B Joint Returns: Gross Income, Adjustments, Deductions, Exemptions, Taxable Income and Taxes Under 1983 and 1988 Law 108
4.2A All Itemizer Returns: Gross Income, Adjustments, Deductions, Exemptions, Taxable Income and Taxes Under 1983 and 1988 Law 112
4.2B Joint Itemizers Returns: Gross Income, Adjustments, Deductions, Exemptions, Taxable Income and Taxes Under 1983 and 1988 Law 117
4.3 Correspondence Between Table 4.1A, 4.1B, 4.2A, 4.2B, and 1983 Form 1040 123
4.4 Tax Return Income, Additional Items in Economic Income, and Tax Items for Families in 1983 125

Tables **Page**

Don Fullerton, Robert Gillette, and James Mackie

5.1 Cost Recovery Periods in Fullerton (1987) 136
5.2 Cost Recovery Parameters in the Corporate Sector 138
5.3 Personal Tax Rates 141
5.4 Present Value of Cost Recovery Allowances for Corporate Assets 144
5.5 Asset Specific Investment Incentives in the Corporate Sector 146
5.6 Summary Measures 148
5.7 Cost of Capital and Effective Tax Rate by Industry 151
5.8 Components of Tax Reform 152
5.9 Individual Arbitrage Compared with Firm Arbitrage 155
5.10 Alternative Real Rates of Return 157
5.11 Alternative Financing 158
5.12 Influence of Inflation on Effective Tax Rates 161
5.13 Indexation and Effective Tax Rates 163
5.14 Accounting Rules for Multi-period Production 168

Don Fullerton, Yolanda K. Henderson, and James Mackie

6.1 Tax Rate Parameters 177
6.2 Tax Parameters for Each Asset 179
6.3 Investment Incentives for Each Asset in the Corporate Sector 182
6.4 Investment Incentives With New View of Dividend Taxes 184
6.5 Investment Incentives With Old View of Dividend Taxes 184
6.6 Marginal Effective Total Tax Rates for Each Industry 185
6.7 Eventual Allocation of Corporate Capital Across Asset Types 196
6.8 Eventual Allocation of Capital Across Sectors 196
6.9 Eventual Output and Capital Stock by Industry 197

Geraldine Gerardi, Hudson Milner, Leslie Whitaker, and Roy Wyscarver

7.1 Assumptions Underlying Qualified Progress Expenditures 212
7.2 Revenue Changes from the Capital Cost Recovery Provisions in the Tax Reform Act of 1986, 1986-1992 216
7.3 Total Investment by ACRS Depreciation Class Before TRA 86, 1986-1992 218
7.4 Total Deductions by ACRS Depreciation Class Before TRA 86, 1986-1992 219
7.5 Summary of the Effects of the Proposals to Repeal the Investment Tax Credit of TRA 86, 1986-1992 220
7.6 Revenue Estimates for Expensing Provision Changes in TRA 86 221
7.7 Total Investment by TRA 86 Depreciation Class, 1986-1992 222
7.8 Total Depreciation Deductions by TRA 86 Depreciation Class, 1986-1992 223
7.9 Revenue Estimates for Depreciation Schedule Changes in TRA 86, 1986-1992 223
7.10 Summary of the Revenue Changes Associated with Capital Cost Recovery Provisions of TRA 86, 1986-1992 224
7.11 Comparison of Depreciation Systems 226

Tables **Page**

Harry Grubert and John Mutti

8.1 Changes in Sectoral Tax Rates Resulting from Basic Changes in Domestic Taxation 234
8.2 Fully-Phased-In Annual Revenue Increase of Foreign Provisions 236
8.3 Short-Run Impact of Tax Reform 246
8.4 Long-Run Impact of Basic Tax Changes With Varying Degrees of Capital Mobility 247
8.5 Long-Run Impact of Tax Reform Including Passive Loss Rule, Uniform Capitalization Rules, and AMT 249

Lowell Dworin

9.1 Optimal Decision Parameters in the Absence of the Minimum Tax and the Resulting Financial Performance Under Non-Stochastic and Stochastic Economic Conditions 260
9.2 Optimal Decision Parameters in the Presence of the Minimum Tax and the Resulting Financial Performance Under Non-Stochastic and Stochastic Economic Conditions 264
9.3 Financial Results for an "Airline" Earning a Constant Pre-tax Return: The 7% and 13% Cases 269
9.4 Five-Year AMT Revenue Estimates From Conventional (Approximate) and Stochastic (Exact) Procedures, and Percentage Differences 270

Thomas S. Neubig and Martin A Sullivan

10.1 Corporate Tax Rate 284
10.2 Extrapolation Assumptions Used in Banking Model Simulations 289
10.3 Estimated Use of the Experience Bad Debt Reserve Method 290
10.4 Effect of Tax Reform Provisions on Banks' Federal Tax Liability and After-Tax Income Between 1987 and 1991, Total 5-Year Changes 295
10.5 The Effects of Tax Reform on Small and Large Commercial Banks, by Year, 1987-1991 298

Leonard E. Burman, Thomas S. Neubig, and D. Gordon Wilson

11.1 Sample Spread Sheet Calculator for ACRS Low-Income Housing 309
11.2 Three Measures of Effective Tax Rates for Rental Housing Investment in 1985 315
11.3A Effect of Marginal Tax Rates on Rental Housing Investment (Pre-TRA86 Parameters) 317
11.3B Effect of Marginal Tax Rates on Rental Housing Investment (TRA86 Parameters) 317
11.4A Effect of Tax Reform Provisions on User Costs Stacked Separately and Together Compared to 1985 Law (Assumptions I) 319

Tables Page

Leonard E. Burman, Thomas S. Neubig, and D. Gordon Wilson

11.4B Effect of Tax Reform Provisions on User Costs Stacked Separately and Together Compared to 1985 Law (Assumptions II) 320

11.5 Present Value of Low-Income Housing Tax Incentives Relative to 1985 Law 326

11.6 User Cost Estimates Under a Range of Parameter Values 336

11.7 Project Model Estimates of Break-Even Rent Compared to the CPI for Urban Rents Using Historical Values - 1975 to 1985 339

11.8 Input Parameters and Baseline Values 342

11.9 Comparison of Real Estate Tax Provisions Before and After Enactment of the Tax Reform Act of 1986 343

Figures

James M. Cilke and Roy A. Wyscarver

2.1 A Typical Loss Function 48

2.2 Graph of ϕ (x) 52

Don Fullerton, Yolanda K. Henderson, and James Mackie

6.1 A Diagrammatic Summary of the Model 187

6.2 Savings Elasticity and the Welfare Gain from the Tax Reform Act of 1986 193

6.3 Asset Substitution and the Welfare Gain from the Tax Reform Act of 1986 193

6.4 Sectoral Substitution and the Welfare Gain from the Tax Reform Act of 1986 194

Thomas S. Neubig and Martin A Sullivan

10.1 Commercial Bank Actual Net Charge-offs and Estimated Tax Bad Debt Deductions, 1978-1984 291

10.2 Commercial Bank Holdings of Tax-Exempt Loans and Securities 294

Leonard E. Burman, Thomas S. Neubig, and D. Gordon Wilson

11.1 Effect of TRA86 on User Costs 321

11.2 Effect of Tax Rates on User Cost 324

11.3A Long-Run Supply and Demand for Rental Housing Assuming Perfectly Elastic Supply 333

11.3B Long-Run Supply and Demand for Rental Housing Assuming Perfectly Inelastic Demand 333

11.3C Long-Run Supply and Demand for Rental Housing Assuming Constant Elasticity of Supply and Demand 334

11.4 Predicted Versus Actual Rents, 1975-1985 338

11.5 Flow Chart of Treasury Rental Investment Calculator 345

INTRODUCTION

Don Fullerton

President Reagan's State of the Union address of February 1984 started the Treasury Department's Office of Tax Policy on a major year-long project to prepare and analyze myriad interacting provisions of comprehensive tax reform. This project was undertaken by economists in the Office of Tax Analysis and attorneys on the staffs of the Tax Legislative Counsel and International Tax Counsel. The project resulted in the November 1984 Treasury Department Report to the President Tax Reform for Fairness, Simplicity, and Economic Growth, and the May 1985 President's Tax Proposals to the Congress for Fairness, Growth, and Simplicity. After extensive Congressional deliberation on those and many other proposals, the President signed the Tax Reform Act of 1986. This Act included many of the Treasury Department's original tax reform proposals.

Economic analyses of the various tax reform proposals involved novel and path-breaking approaches to new public policy issues. Economists in the Office of Tax Analysis (OTA) had to analyze hundreds of different tax proposals for their effects on economic efficiency, distribution, and revenue. These analyses required the development of many different economic models and databases. During the development and legislative consideration of this historic tax reform, OTA economists generally did not present their research for wider dissemination.

This Compendium includes eleven papers by OTA staff. The papers provide descriptions of some of the most important quantitative methods and models used at the Office of Tax Analysis. The papers focus on diverse aspects of the domestic and international economy, and they provide new results about the potential effects of the Tax Reform Act of 1986.

Wider dissemination of research results and methodologies is essential to remain at the frontiers of any field. Researchers benefit from critical review and suggestions. Moreover, other economists are interested in the

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I would like to thank all of the staff of the Office of Tax Analysis and particularly the authors for help with the summaries of their papers.

research of OTA economists and might use it to do new research that could advance future analyses of tax policy. Indeed, most economists have been concerned almost exclusively with the distributional and efficiency effects of taxes, ignoring methods of revenue estimation that were so crucial to the development of "revenue neutral" tax reform. Other economists can learn from the path-breaking work of Treasury economists, suggest improvements, and push further the frontiers of tax policy analyses. Such an interchange is one purpose of this Compendium.

Wider dissemination of research results and methodologies can also clarify misunderstandings and focus attention on critical issues in need of further research. One example of an important misunderstanding is that critics of revenue estimates accused Treasury economists of using "the assumption that the loophole closings and lower rates will have no effect whatever on the behavior of taxpayers, the growth of taxable income or anything else in the economy" (Wall Street Journal editorial, April 3, 1985). Despite explanations from the Treasury, the belief persisted that "revenue estimates are based on static analyses, which assumes that cutting rates X% will reduce revenues X%. By now everyone knows that this is crudely inaccurate" (Wall Street Journal editorial, August 5, 1986). Disagreements about the assumed degree of behavioral response will remain, but this Compendium should finally debunk the myth of static revenue estimates.

The Office of Tax Analysis staff uses a diverse array of computer models to perform their analyses of the effects of a tax change on economic behavior, government revenue, the distribution of tax burdens, and the efficiency of the economy. The staff works with large samples of individual, corporate and other tax returns, demographic data from the Bureau of the Census, production data from the Bureau of Economic Analysis, consumption data from the Bureau of Labor Statistics, and other data from many sources. These data are combined in various ways using the latest statistical techniques, providing a detailed picture of the sources and uses of income for a large sample of taxpayers and families. Analysts can then "simulate" the effects of changes in a tax, even one that does not exist yet, by calculating the new tax liability and behavioral response of each taxpayer and family in the sample.

The next section of this introduction provides a summary of each of the eleven papers in the Compendium. It describes the nature of the models that are used and the provisions of the Tax Reform Act of 1986 that are analyzed, and it summarizes the results. A final section of the introduction comes back to the issue of model-building. That section discusses the appropriate size and use of different models, interrelationships among models, and how some of the models might be improved.

SUMMARIES OF THE PAPERS

The first paper is "A Guide to Interpreting the Dynamic Elements of Revenue Estimates," by Howard W. Nester. This paper is a good starting point because it outlines in general terms the process involved in estimating Federal revenue. Such estimates might be provided for legislative proposals or for budget receipts under the existing tax system. The paper includes discussion of the objectives of revenue estimates, different types of behavioral assumptions, issues in their interpretation, and examples of behavioral responses included in Treasury estimates of the Tax Reform Act of 1986.

The main message is that Treasury estimates contain many microeconomic behavioral responses but are constrained within the macroeconomic forecast of the Administration. However, the Administration macroeconomic forecasts themselves often include induced effects such as increases in GNP or investment resulting from tax changes, even though these are not directly attributable to any single tax law provision.

Chapters 2-4 discuss the design and some applications of the Treasury Individual Income Tax Model and Database. The second paper in this volume is "The Treasury Individual Income Tax Simulation Model," by James M. Cilke and Roy A. Wyscarver. This paper explains the motivations of the Treasury in building their largest single model, listing the many diverse uses of the model. Included is a short history and basic outline of the model. The paper goes on to describe in detail the data bases used by the model, how they were merged to provide a comprehensive picture of each household in the sample, how missing items were imputed, how the components were individually "aged" to represent later years, and how the whole data set was extrapolated over the future five-year budget period.

The paper also describes the computer programs for the model, and it provides a description of the tax calculator. It presents a narrative account of how the model was used during the tax reform process, and it includes some basic model tabulations. For example, it shows how tax reform lowers the average (over all taxpayers) of marginal tax rates on wages, interest, dividends, and noncorporate income, while raising that on capital gains. Finally, the paper discusses future modifications to the tax model.

The third paper is "Family Economic Income and Other Income Concepts Used in Analyzing Tax Reform," by Susan C. Nelson. It points out that the apparent distributional consequences of fundamental tax reform depend to a large extent on the way taxpayers are classified, that is, on the income measure used and the unit of analysis chosen. The paper examines the implications of analyzing taxes on the basis of families rather than tax units, of including nonfilers as well as filers in the analysis, and of choosing income measures broader than adjusted gross income (AGI).

In particular, the paper focuses on the concept of economic income, as defined by Haig and Simons, and on attempts by the Treasury Department to measure it for Treasury I and the President's Proposals. Measured "economic income" is compared to personal income in the National Income and Product Accounts, to AGI, and to the measure used recently by the Joint Tax Committee, here termed "modified expanded income" (MEI). The paper discusses some of the difficulties in attempting to quantify the Haig-Simons concept with available data, most importantly the treatment of pensions, corporate income, and capital gains. Finally, it compares the conclusions that would be drawn about the distributional consequences of the Tax Reform Act of 1986 if the change in taxes is analyzed by AGI of returns, MEI of adult returns, or by "economic income" of families. It finds that the method of classification can substantially affect the apparent distributional consequences of reform.

The fourth paper in the Compendium is "Tabulations from the Treasury Tax Reform Data Base," by James R. Nunns. The Treasury tax reform data base is a microdata file that contains 198,000 "records." Each record represents a tax return (or potential tax return) and contains a large number of tax and nontax variables. Also, each is associated with other tax returns (of filers and nonfilers) in its family unit. Tax returns are appropriately weighted so that the file represents the entire U.S. population. All data items are at 1983 levels. Earlier papers in this Compendium show how the data base is constructed, how it is used, and how income is defined.

The tabulations presented here supplement these earlier papers, showing major tax and nontax items in the data base. The tabulations are divided into two sets. The first set covers major tax variables under 1983 law and post-tax reform law (1988 law), for tax returns of filers classified by adjusted gross income. Separate tables are shown for all returns, joint returns, all returns that itemize deductions, and joint returns that itemize. These tables are designed to show the major impacts of the Tax Reform Act of 1986 in a format useful to state tax analysts and others working with tax return data. The second set of tabulations is aimed at analysts interested in the relationship between adjusted gross income and economic income. This set, which consists of a single table, shows the major items in economic income for families, by economic income class.

The remaining chapters describe models dealing with various aspects of the taxation of business income. The fifth paper is "Investment Incentives Under the Tax Reform Act of 1986," by Don Fullerton, Robert Gillette, and James Mackie. The paper begins by noting that the Tax Reform Act of 1986 contains multiple changes to the taxation of income from capital. The Act substantially lowers the top statutory marginal rate on corporate income as well as personal tax rates on interest and dividend income. In contrast, the Act would eliminate the 60 percent capital gains exclusion and thus raise the effective personal rate on realized capital gains. The Act also changes capital cost recovery provisions by repealing the investment tax credit and replacing ACRS with a system of 8 recovery classes ranging in length from 3 to 31.5 years. In addition, the Act increases the number of costs that must be capitalized into the basis of self-constructed property (including inventory), rather than expensed.

This paper analyzes the combined effect of these changes on marginal investment incentives. It uses the cost of capital framework introduced by Hall and Jorgenson but extends existing work by (a) including the effect of accounting rule changes on the taxation of self-constructed assets, (b) using a more disaggregated capital stock matrix, and (c) incorporating detailed calculations of weighted-average personal marginal tax rates from the Treasury individual tax model. Sensitivity analysis indicates that the actual final effect of TRA on aggregate investment incentives is uncertain. For most cases the paper finds that aggregate investment incentives are somewhat reduced, but variations in effective tax rates across assets and sectors are also reduced.

The sixth paper is "Investment Allocation and Growth Under the Tax Reform Act of 1986," by Don Fullerton, Yolanda K. Henderson, and James Mackie. It makes use of the cost of capital framework further developed in the previous paper. This type of analysis played an important role in evaluating the effects of tax reform proposals, but it is traditionally partial equilibrium in nature. For example, the previous paper notes that the Tax Reform Act of 1986 may slightly reduce overall investment incentives, and thus reduce investment, but that it also reduces the variance in the effective tax rates across assets and thus encourages more efficient utilization of existing capital. The net effect is ambiguous.

To assess the likely net effect, this paper uses a general equilibrium model developed by Fullerton and Henderson. It integrates disaggregate marginal cost of capital analysis with the computable general equilibrium model for tax policy developed by Fullerton, John Shoven, and John Whalley. General results suggest that the capital income provisions of the Act have a positive net effect, despite reduced aggregate investment and saving incentives. That is, the efficiency gains from more neutral taxation more than offset the adverse effects of reduced investment incentives. Again, however, sensitivity analysis indicates that the results vary across different parameter assumptions.

The seventh paper is "The Treasury Depreciation Model," by Geraldine Gerardi, Hudson Milner, Leslie Whitaker, and Roy Wyscarver. While the previous two papers concern the effects of capital cost provisions over the life of each asset under broad sets of conditions, this paper describes the data and model used for calculating budget-period revenue estimates for changes in depreciation rules. These revenue estimates played a major role in determining the degree of corporate rate reduction that could be achieved through tax reform. The depreciation model calculates deductions and investment tax credits on the basis of investment estimates by type of asset for a set of industries. Tentative deductions and credits are adjusted to reflect those that must be carried back or forward as a result of inadequate taxable income. Thus, the model operates between the macro level (where investment can be forecast) and the micro level of the firm (where detail is adequate to evaluate alternative proposals). This paper describes the sources of the data and the operation of the model. It also discusses the results of simulations that evaluate the depreciation changes and repeal of the investment tax credit contained in the Tax Reform Act of 1986.

The eighth paper is "The Impact of the Tax Reform Act of 1986 on Trade and Capital Flows," by Harry Grubert and John Mutti. This paper uses a four-sector, two-country general equilibrium model of the U.S. and the rest of the world to assess some of the international implications of tax reform. The model includes (a) the basic changes in corporate and personal taxation, (b) the changes in the U.S. tax on international investment income, and (c) the change in export tax incentives. The last of these includes both the reduced effect of Foreign Sales Corporations and the interaction of the source rules with the large increase in the number of firms in excess foreign tax credit positions. An attempt is also made in some simulations to introduce the impact of the passive loss rule, the corporate alternative minimum tax, and the uniform cost capitalization rules.

The domestic changes increase the cost of import-competing goods and non-traded goods relative to export goods, so incentives to export increase. Results indicate that both exports and imports will increase in the long run, but the changes in trade and sectoral output are small. Also, some investment will flow abroad because the U.S. tax on foreign investment income declines relative to the tax on domestic income. In the short run, this capital outflow causes an improvement in the trade balance; in the long run the increased net investment income from abroad offsets the increased capital outflows and leaves the trade balance virtually unchanged. In summary, the international dimensions of the Tax Reform Act of 1986 are not dramatic. The simulations also suggest that changes in the merchandise trade balance are not a good indicator of U.S. welfare or of sectoral outputs.

The ninth paper is "Impact of the Corporate Alternative Minimum Tax: A Monte Carlo Simulation Study," by Lowell Dworin. Complicated minimum tax provisions are often omitted altogether from cost of capital analyses such as those discussed above. Revenue estimates include these provisions, but they typically take a sample of firms and project forward on the basis of fixed economy-wide forecasts. Yet a firm's exposure to the alternative minimum tax (AMT) depends upon variations in its gross profit margin, its rate of growth, and its financial leverage. This paper develops a Monte Carlo simulation model of corporations based on the Hayashi model of the firm, incorporating random variations in gross profit margins. By parameterizing the firm's investment and financial decisions, the model calculates endogenously the firm's chosen growth rate and degree of financial leverage under alternative tax policy options.

This model is used to examine the impact of the AMT under both uniform and stochastic economic conditions. It is shown that the firm's frequency of exposure to the AMT may be significantly greater under stochastic conditions. It is also shown that when the response of the firm to its tax environment is endogenous, the impact of the AMT on the firm's tax payments is much greater than when the response is ignored. However, the results are somewhat ambiguous regarding the importance of incorporating stochastic modeling in the revenue estimation process.

The tenth paper is "The Effect of the Tax Reform Act of 1986 on Commercial Banks," by Thomas S. Neubig and Martin A. Sullivan. This paper deals with another area where the standard corporate data and model might not be adequate to evaluate the Tax Reform Act of 1986. Base-broadening provisions specific to banks include the repeal of the bad debt reserve method, the recapture of existing bad debt reserves, and the disallowance of interest costs used to carry tax-exempt securities. Especially for banks, therefore, corporate tax return data do not include all of the information on loans, book income, and receipts of tax-exempt interest that is necessary to model tax reform proposals. This paper describes the banking tax model that employs an extrapolated cross-section time-series regulatory accounting database to simulate alternative tax reform proposals.

These bank-specific provisions and the alternative minimum tax are commonly highlighted when assessing the effects of tax reform on banks. However, this paper shows that the added Federal tax liability attributable to these provisions is almost entirely offset by rate reduction. Although banks as a whole pay more taxes over the 1987-91 period, after-tax incomes may actually increase because additional interest income is earned when banks shift their portfolios from tax-exempt to taxable securities. The paper goes on to compare large and small banks, to evaluate alternative loan-loss scenarios, and to consider future extensions of the model.

The eleventh and final paper in this volume is "The Use and Abuse of Rental Project Models," by Leonard E. Burman, Thomas S. Neubig, and D. Gordon Wilson. Using techniques much like those in the cost of capital analysis described above, "rental project models" consider the entire life of a hypothetical marginal investment in residential or commercial rental property. Assuming certain economic conditions, these models can calculate the rent that would have to be charged to provide a predetermined "required rate of return" to an investor with specific tax characteristics. During tax reform, rental project models were used frequently to support both sides of debates about the proper tax treatment of rental property.

This paper first documents the Treasury rental project model and its improvements over existing analyses. More importantly, the paper shows why existing rental project models produce very disparate results. These models use different assumptions about the marginal investor, for example, and thus generate different required rent levels. The results show incentives for particular individuals or institutions to buy or sell each type of rental property, but the results for any one investor do not necessarily indicate what will happen to market equilibrium rents. The paper thus provides some useful guidelines for understanding and critically evaluating rental project model analyses. Despite their limitations, rental project models can provide valuable insights about how tax policies can affect individual investors' behavior and how current and future subsidies are capitalized into land values. As examples, the paper examines the effects of various provisions of the Tax Reform Act of 1986 on holding periods and asset values under various parameter assumptions.

DISCUSSION

The papers provide interesting analyses of many diverse effects on the economy of changes to individual, corporate, domestic, and international tax rules in the Tax Reform Act of 1986. Accordingly, they are very useful. An overall evaluation of the Act would not be warranted here, however, because (a) these eleven papers do not cover many other economic effects of tax reform, (b) results are sensitive to alternative assumptions, (c) observers will legitimately differ on the desirability of particular effects, and (d) these papers do not attempt to incorporate noneconomic objectives and effects of tax reform. Summary judgment about tax reform can be made only by combining results here with those of other studies, and with subjective beliefs.

Instead, these papers are primarily about research developments. The Tax Reform Act provides a highly relevant set of tax changes for the application of these analytical techniques. Therefore, a more appropriate form of summary discussion involves the state of the art available for analyzing tax policy, and how it might be improved.

Most of the papers include some discussion of specific changes that might improve the use of the relevant model. It is always possible, for example, to search out more and better sources of data, to incorporate more detailed features of tax law and economic decisionmaking, to better estimate the behavioral reactions, and to perform more sensitivity analysis. There is always more work to be done on disaggregation, the effects of uncertainty, and interactions with other markets. The rest of this introduction will raise a few more fundamental questions about the nature of the model-building process.

A first fundamental question is the degree to which economic models are useful. Indeed, the effects of tax policy cannot even be discussed without an implicit or explicit model of empirical magnitudes, economic behavior, and logical consequences. The advantages of an explicit economic model include the care in establishing empirical magnitudes, the rigor in defining behavioral reactions, and the confidence in avoiding logical errors by writing down and solving the model. It cannot predict the future, but an economic model can clarify which assumptions are most important, whether some qualitative results can be stated with confidence, and what range of empirical outcomes is most likely.

A second question involves the appropriate size of the model. The Treasury's individual tax model is described in the paper by Cilke and Wyscarver, used in the paper by Nelson, and tabulated in the paper by Nunns. It includes 198,000 tax returns and takes a half-hour of computer time to solve. It requires several staffers to maintain and to set up runs. For most calculations, in fact, the results are not significantly affected by adding the last few thousand tax returns or making the last few hours of refinements to the model. It is a general purpose model, however. There is some advantage in using the same model to answer a series of different questions, some of which might involve narrowly defined types of income. It may take 198,000 returns to find enough of that income in each bracket to have sufficient confidence in the distributional results of changing its tax treatment. Still, it is legitimate to ask when the detail provides an improvement; estimates of behavioral parameters vary by large orders of often magnitude, or even by sign. Results can depend on the assumed parameter in a small model the same way they do in a large model.

A third and related question is when to stop expanding one model and start building another. The economist must always make a judgment about the marginal benefits of continuing to improve the answers from one model, a choice that necessarily means accepting a given framework and set of assumptions, compared to the benefits of starting with a new framework but less detail. An example is given by the large corporate model that has thousands of tax returns and projects over the budget period for each corporation by using economy-wide forecasts. This model gives highly detailed answers and is essential to address particular aspects of corporate income and activity. Its use necessarily involves accepting its assumptions. Nevertheless, the economist must choose which questions are most important to address and which assumptions are key to the answers obtained. Dworin's paper describes a small model used to investigate the assumption of uniform profits and growth. This model essentially takes a set of examples and cannot be used by itself to estimate economy-wide effects on revenue or corporate income, but it is a tremendous aid to the use and interpretation of results from the corporate model.

A fourth question is whether two or more models can or should be linked together. The endogenous financial and other behavior of Dworin's model could be incorporated into the detailed calculations of the corporate model. For that matter, they could be linked simultaneously with the bank model described in the paper by Neubig and Sullivan or with the corporate part of the depreciation model described in the paper by Gerardi, Milner, Whitaker, and Wyscarver. Again it is a judgment, but often such linkages are unwise; bigger is not necessarily better. Even if two models appear to cover some of the same tax laws or taxpayers, they may deal with separable economic phenomena. Little may be gained if one phenomenon is not directly influenced by the other, and much may be lost in terms of the ease of model use, interpretation, and tractability.

To take another example, the depreciation model obviously deals with many of the same provisions as the cost of capital model in the paper by Fullerton, Gillette, and Mackie. That model calculates present values of depreciation deductions for many diverse assets, averaging over the economy to get overall investment incentives. It therefore uses similar data on asset use by industry. There might at least be some advantage to the consistency of using the depreciation model to calculate these present values. However, the goals of the two models are different. The depreciation model is concerned with measuring actual tax revenue over the next five years only, using Administration forecasts of interest rates, inflation rates, and other macroeconomic variables. It uses gross investment forecasts, and it is sometimes concerned with changes in narrow asset categories. In contrast, the cost of capital model is concerned with incentives for capital formation in general. It requires depreciation over the life of each asset and weights given by capital stocks rather than gross investment. Moreover, part of the point of the cost of capital model is to see how incentives vary with changes in the interest rate, inflation rate, or other macroeconomic variables. Often qualitative results are robust to variations in these parameters, but when quantitative results vary significantly with a single unknown parameter like the future interest rate, there may be little point to further refinements in the detail of depreciation deductions in narrow asset categories.

Finally, perhaps the most important question involves the use and interpretation of model results. In particular, policymakers generally use a single point estimate rather than qualitative results or a range of answers. It is sometimes difficult for the economist to convey a sense for the degree of confidence to place in the results. For example, the paper by Nester describes how revenue estimators make judgments about the relevant elasticity parameters when including behavioral effects. They know that results vary with these assumptions, and they perform sensitivity analysis, but the Budget requires point estimates for receipts and outlays. One point of the paper about rental project models, by Burman, Neubig, and Wilson, is that this kind of model can generate virtually any kind of result desired, by adept variations in key parameters.

Sensitivity analysis is particularly important for general equilibrium models such as in the paper by Grubert and Mutti or by Fullerton, Henderson, and Mackie, because of the sheer number of behavioral parameters that must be assumed for demand and for supply of each good in each market. Both of those papers include considerable sensitivity analysis, but it is hard perhaps for the reader to know that the authors have in fact sufficiently varied the parameters that are most important. Also, as discussed above, the results may be sensitive to model form in a way that is difficult to vary.

All of these questions provide topics for further research. Future developments will undoubtedly provide further detail in existing models, investigation of new models, and formal or informal linkages among models. Informal linkages might involve using the results of one model as an input to another model. It might be fairly straightforward, for example, to take new relative prices from a general equilibrium model and insert them into a revenue estimating model. A further refinement would take the subsequent results of the revenue estimating model and insert them back into the general equilibrium model. Formal linkages might involve simultaneous solution through iteration. The problems are formidable, however. Even the direction of price changes in general equilibrium models can be sensitive to modeling choices, and it may be unwise to accept a single set of choices for point estimates. Also, such linkages can easily become unwieldy. For operational purposes, the decision to fix some relative prices in revenue estimating models has its advantages. Informal linkages might best insert only the price changes that are known with confidence.

Recognizing the uncertainty about economic effects of tax proposals makes enacting any reform more difficult. There is no easy solution to this problem. This volume, however, will help clarify some of the problems encountered by economists when analyzing alternative tax policies, and the advanced nature of the methods available currently to address these problems.

1 A GUIDE TO INTERPRETING THE DYNAMIC ELEMENTS OF REVENUE ESTIMATES

Howard W. Nester

I. INTRODUCTION

Over the three year period 1984 through 1986 the Department of the Treasury's Office of Tax Analysis (OTA) was responsible for analyzing several broad approaches to reforming the Internal Revenue Code and countless proposals to enact changes to specific provisions. One of the outputs of the process was a series of revenue estimates associated with each proposal or group of proposals. Summaries of the revenue estimates were published in both of the Department of the Treasury's tax reform volumes, Tax Reform for Fairness, Simplicity, and Economic Growth ("Treasury I")[1] and The President's Tax Proposals to the Congress for Fairness, Growth, and Simplicity ("Treasury II").[2] The Administration's summary estimates of the enacted tax reform bill were released in the Administration's Fiscal Year 1988 budget (a more detailed version is included as an appendix to this paper).[3] Similar estimates were released by the Joint Committee on Taxation.[4] This paper is intended as a guide for those seeking a better understanding of how to accurately portray and interpret these and similar revenue estimates. It outlines the major principles and assumptions that go into such estimates. It also responds to criticisms about the "static" nature of revenue estimates by presenting examples of several major tax reform provisions for which behavioral responses were a significant consideration in making the estimates.[5]

In Section II the overall approach to making revenue estimates is described. Major assumptions underlying revenue estimates are discussed in Section III. Issues in formatting and presenting a table of revenue estimates and in interpreting the resulting totals are discussed in Section IV.

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Section V includes examples of major behavioral responses included in revenue estimates. Section VI comments on the accuracy of the methodology and assumptions used by OTA and Section VII summarizes.

II. OVERALL DESCRIPTION OF REVENUE ESTIMATES

The Office of Tax Analysis (OTA) has primary responsibility for producing forecasts of unified budget receipts for inclusion in the Administrations' budget submissions and internal reviews and for estimating the effect on collections of enacted or proposed changes in tax laws. These estimates generally include projections of receipts under current law and/or proposed law for the next five years. To the fullest extent possible, the Department's estimates are based on the Administration's economic forecast. This forecast, which consists of an integrated set of GNP accounts and other subsidiary economic series, is circulated to all Executive Department agencies for use in preparing receipt and outlay estimates for each major budget exercise.[6] This serves to ensure consistency across all estimates and as a check on overall magnitudes; it also ensures that all of the pieces "add up" and that aggregate income is consistent with aggregate demand, including government purchases.

For each budget exercise, forecasts of receipts by source (e.g., individual income taxes, corporate income taxes, deposits by the Federal Reserve system, etc.) are generally based on models comprised of time series regression equations used to forecast aggregate tax liability, form of payment (such as withheld taxes, estimated taxes, and additional taxes paid as a result of audits), and the relationship between form of payment and the actual timing of collections.

As a result of the frequent modification of tax laws since 1975, the basic approach used in receipts estimating is to forecast "constant law" tax liabilities and add on separate estimates of the impact of changes since the base year. These separate (revenue) estimates are generally those derived at the time the tax bills were under consideration, modified as necessary for changes in economic conditions and additional information since the initial estimates were made.

Each revenue estimate consists of a series of summary statistics indicating the expected change in calendar year liability and/or fiscal year tax collections as a result of enacted or proposed changes in tax law.

Ideally each revenue estimate is based on:

- A forecast of economic activity directly relevant to the proposal (e.g., investment by businesses in plant and equipment to estimate the effect of changes in depreciation rules);
- A set of tax rules governing the recording of the transactions for purposes of measuring taxable income;
- The applicable marginal tax rates; and,

° A set of rules for making tax payments and a forecast of taxpayer response to these rules.

In general, revenue estimates associated with changes in tax law are generated using micro-simulation models of actual tax returns, recalibrated to reflect the aggregate economic forecast. The principle micro level models are the Individual Tax Model and the Corporate Tax Model. Examples of other models used by the Office of Tax Analysis include a depreciation model (see Gerardi, et al., this volume), banking tax model (see Neubig and Sullivan, this volume), and an insurance company tax model.

III. ASSUMPTIONS AND GUIDELINES UNDERLYING REVENUE ESTIMATES

A. Proposals Developed in Conjunction with the Administrations' Budget – Consistency With the Economic Forecast

The Administration's economic forecast is used, to the fullest extent possible, to forecast the relevant economic activity. This not only ensures consistency across estimates, it also serves as the way in which second-order effects are taken into account in estimates for budget purposes. That is, in those instances where tax policy initiatives included in the budget are held to have measurable effects on aggregate economic activity, those effects are built into the final forecast. The process by which this is accomplished is an iterative one in which Treasury first makes estimates of a proposal using a base forecast and then transmits the results to the Council of Economic Advisors who, in turn, use the results as inputs to rerun the overall forecast. Treasury then uses the next forecast as a revised input for the revenue estimate. During preparation of the President's annual budgets two or three interactions of this sort are all that are necessary to approximate a simultaneous macroeconomic model solution.

B. Assumptions When New Proposals Are Estimated

Estimates of proposals not developed as part of a comprehensive budget process are based on the most recent Administration forecast, in which the major elements of the forecast remain unchanged. The working assumption is that, over the five-year budget horizon, the aggregate production of goods and services–and associated incomes from current production–are determined by real variables interacting with the Administration's fiscal policy decisions. However, it is specifically recognized that although aggregate levels may be relatively fixed, the composition of the variables underlying the totals will change much more quickly. To the extent possible. revenue estimates take these compositional shifts into account. The following section lists some of the economic variables in the forecast that are held constant, those that may change depending in the proposal and those–not explicitly part of the forecast–that may also be changed.

Items Held Constant. Specific elements of the economic forecast that are generally held constant across all revenue estimates include:

- Total GNP;
- Interest rates;
- Total employee compensation arising in the production of goods and services (wages, salaries, and supplements);
- Total gross private domestic investment;
- Overall price index; and
- Total level of state and local taxes.

Items That May Change. Examples of elements of the economic forecast that are changed as appropriate include:

- The composition and level of nonwage personal income (proprietors' income, rental income, dividend income, and interest income);
- The mix of employee compensation;
- The mix of state and local tax revenues;
- The mix of gross private domestic investment between equipment and structures; and
- Distribution of income between corporate and noncorporate forms of business.

Items Not Part of the Forecast. Other economic variables that are not specifically part of the economic forecast that are taken into account in revenue estimates include (examples can be found in Part IV):

- Changes in holdings of financial assets;
- Changes in activity not includable in the GNP accounts (taxable activities that are not a result of the production of goods and services); and
- Accounting changes in the recording of transactions for tax purposes.

C. Other Assumptions

Several other assumptions underlying revenue estimates should be noted:

1. Compliance and Enforcement

In general, overall levels of compliance and enforcement are held constant from those implicit in base line receipts estimates. Proposed changes in tax law are assumed to be accompanied by the resources necessary to ensure their effectiveness. This is generally assumed to be accomplished by reallocation of existing resources. Of course, estimates are made for specific proposals, such as increasing the number of IRS personnel or additional reporting requirements, which are directly intended to increase audit coverage and/or taxpayer compliance over the historic norm. Estimates of these and similar proposals will include estimates of the direct effect of the proposal on tax collections and, to a much more limited extent, additional revenues associated with some taxpayer compliance response to the proposal.

A major exception to the general practice in this area was made in the case of the estimates of the tax reform bill: the large reduction in individual tax rates is projected to have a positive net effect on overall individual compliance levels despite the base broadening and tax-shelter provisions of the tax reform bill (which have the opposite effect since they raise tax payments by individuals utilizing such preferences). (See Item V.K. in the tax reform summary table in the Appendix).

2. Payroll Taxes

Although tax base broadening proposals may also increase the tax base for determining payroll (OASDHI) taxes, revenue estimate tables generally exclude changes in payroll tax revenues under the assumption that OASDHI rates will be set in the future to offset changes in the payroll tax base (in effect assuming that there is a target revenue level that the trustees have set). An exception is made for proposals which purposely alter the tax rate or base (the assumption is that such proposals are aimed at altering the target trust fund balances).

3. Taxpayer Options

In many instances the Tax Code allows taxpayers options in accounting for a transaction and for satisfying payment requirements. Revenue estimates will generally reflect past taxpayer practice even though that practice does not appear to minimize current tax payments. For example, collections data indicate that many individual taxpayers deliberately chose to be overwithheld or to overpay estimated taxes despite the existence of options and safe-harbor rules which would permit lower payments. This pattern is reflected in revenue estimates.

However, where there are no data to indicate otherwise, OTA generally assumes that taxpayers maximize their after-tax income, even though taxpayer-specific conditions may exist such that a taxpayer would choose an alternative option over the revenue horizon. For practical purposes tax-minimizing behavior is assumed to consist of accelerating deductions and delaying recognition of taxable income to the fullest extent possible. For example, a taxpayer may have an option to deduct or to capitalize a given expenditure. Absent other information, the revenue estimate is made assuming that the taxpayer will fully deduct the expenditure in the earliest period possible.

4. Pre-Enactment Effects

One problem that occurs in assessing the impact of a tax proposal is the issue of how to account for pre-enactment effects. Taxpayers, of course, react in anticipation of changes in tax laws and these reactions affect tax deposits. These effects remain no matter what ultimately happens to the law. For example, there is evidence that taxpayers accelerated their payments of estimated taxes and audit taxes from future years into FY 1986 to avoid possible underpayment penalties and to stop accrual of potentially nondeductible interest. Another example is the accelerated purchase of business equipment in 1985 in anticipation of the repeal of the investment tax credit widely speculated to occur on January 1, 1986 (which the new law eventually did). These effects are reflected in both recent GNP totals and in collections data, and they become part of budget receipts equations. As a result, these effects are generally incorporated in the base budget receipts forecast and are not included in a revenue estimate table.

5. Post-Enactment Effects

Revenue estimates assume continuation of tax law as enacted (or as proposed) and, in keeping with the economic forecast, do not include assumptions as to taxpayers' anticipations of the course of future tax policy. For example, termination of a tax credit for a tax-favored economic activity might be expected to generate accelerated (additional) expenditures in the year or two prior to expiration. This behavioral response would be taken into consideration in making an estimate of the net cost of the credit. Alternatively one might argue that taxpayers fully anticipate continuation of a popular credit and no such "bunching" prior to expiration would occur. This anticipation is not included as part of a revenue estimate.

Capital gains estimates are another example. If realizations are a function of, among other things, taxpayers' anticipations as to the course of future tax rates, then the levels of realizations will change over the course of the year as expectations change. Again, revenue estimates take the tax system implicit in the initial Administration forecast as the one that actually is in effect over the budget period. It is therefore, by implication and for all practical purposes, also the one that taxpayers would be expected to anticipate as each year progresses.

6. Other Tax-favored Activities

Revenue estimates will reflect any anticipated shifting of income and/or deductions towards alternative known tax-favored activity. For example, revenue estimates of eliminating one form of tax-deferred personal income payments will include offsets due to shifting to other remaining deferral devices. However, revenue estimates do not assume the creation and use of new, as yet unknown, "shelters". In the absence of clear alternatives, any shift in the tax base as a result of tax law changes is assumed to be from or to fully-taxable activity.

IV. ISSUES IN FORMATTING AND INTERPRETING A TABLE OF REVENUE ESTIMATES

Before discussing some of the specific areas where behavioral assumptions played a significant role in estimating the revenue effects of tax reform, it is useful to note problems associated with producing and interpreting a table that contains more than one revenue estimate, such as the one for the Tax Reform Act of 1986 in the Appendix. Users of revenue estimates will frequently misinterpret the meaning of revenues attributed to specific provisions and, as a result, assume that the estimate excludes components they believe should be included (or vice versa).

Stacking Order Issues. The most difficult issue facing the creator of a table of revenue estimates is the determination of the level of aggregation and the "stacking order" that is used to present results to the user. There are three main possibilities for presenting line-by-line estimates. First, each proposal could be estimated in isolation against current law with a separate line for displaying interactions among proposals (a "stacked first" table). Second, each proposal could be estimated assuming all other proposals are already in the law, again with a separate line for displaying interactions among proposals (a "stacked last" table). Finally, the proposals can be displayed using a sequential stacking order whereby each estimate assumes all prior proposals are already in the law (a "stack-up" table).

Assume an extreme example of a package with three separate proposals, each of which has the effect of closing the same "tax loophole" and generating $100 of additional tax payments. In a "stacked first" table each proposal might be shown to generate $100, and the table would include a line showing an interaction effect of -$200. In a "stacked last" table each proposal would show a zero revenue effect and the interaction line would show a positive $100 revenue effect. Finally, a "stack-up" table would attribute the $100 of revenue gain to the first proposal listed, zero to the other two proposals, and would have no entry in the interaction line.

As a result of the sequence through which Treasury I and Treasury II were developed, revenue estimates were made and presented in the summary tables following a specific "stack-up" format. The general pattern was to repeal credits first, estimate base-broadeners second, estimate the effect of rate reductions third, and estimate the effect of changes in the minimum tax last. The tax reform revenue estimate table prepared for use in the Administration's FY 1988 Budget has most individual provisions stacked last. These estimates are shown in the Appendix table. Thus, this table has an interaction term (Item I.A.7). Provisions affecting corporations continue to be stacked following a specific sequence (see introductory text in the Appendix).

It is obvious that line entries will vary from table to table depending on the stacking order used and that they will represent answers to different questions. No single table format covers all possible options. Some of the confusion surrounding revenue estimates can be minimized if users analyzing and interpreting specific entries on a table first determine what is–or is not–included in the line of interest.

Interpretational Issues. As mentioned earlier, a revenue estimate is a summary measure of the change in tax payments over a selected budget period. As such it is a cash flow measure whose primary use is to indicate the extent to which borrowing or other fiscal policies must change. Revenue estimate tables combine the effects of timing proposals (such as changes in the rules for making estimated payments) with the effects of permanent changes in the tax system (such as rate reductions). Analysts must therefore be careful in interpreting revenue estimates of deferral items. Those who combine the revenue effect of timing proposals with the revenue effects of permanent changes have a correct revenue estimate but run the risk of misunderstanding or misrepresenting what has actually changed as the result of a tax proposal. For instance, repeal of the bad debt reserve method for non-financial corporations and "large" banks (Items III.E and IV.A.1) had a large one-time revenue effect from ending deferral on existing reserves with a small permanent pickup.

Another problem with interpreting revenue estimates exists when taxpayers pay "implicit taxes" in the form of lower pre-tax rates of return. After-tax incomes do not necessarily change by the amount of the revenue estimate. For example, changes in the deductibility of interest by commercial banks may result in their substituting taxable for tax-exempt securities with individuals doing exactly the opposite. A revenue estimate table would then show an increase in tax payments by corporations and a decrease in individual payments. Due to higher yields on taxable securities, after-tax incomes in both sectors may remain essentially unchanged. (Item IX.B.)

V. SPECIFIC EXAMPLES OF BEHAVIORAL ASSUMPTIONS THAT ARE INCLUDED IN OTA REVENUE ESTIMATES

This section discusses examples of behavioral responses that are typically included in Treasury revenue estimates (with emphasis on tax reform estimates). In some instances explicit modeling of taxpayer responses is necessary because the economic forecast either does not or cannot effectively take them into account. Examples include proposals affecting capital gains realizations (which do not arise from current production and are therefore excluded from GNP accounts) and the effects of proposals not included in the original budget compilation.

In other instances estimating taxpayer responses is quite clearly a necessary step in more accurately portraying the ultimate effect of a tax proposal on tax receipts. Examples include shifting of portfolio holdings by individuals, additional or altered borrowing patterns, and effects on mergers and acquisitions in response to changes in tax law.

Examples of behavioral responses included in tax reform estimates (item references are to entries in Table 1.1 in the Appendix):

A. Payment responses

One of the more important (and frequently overlooked) components of a revenue estimate is the assumption as to taxpayers' "payment response" to proposed changes in tax law. Variations in payment patterns can significantly affect the timing of collections over a forecast period. The problem is that there are several options available to taxpayers in the tax code for satisfying requirements for making timely payments of estimated taxes and final tax liability. Revenue estimators must take these options into account. At the same time, changes in tax law–particularly major changes–will be accompanied by an adjustment period in which taxpayers move along a "learning curve" and gradually adapt to the new law, overstating and understating tax payments until the desired level is reached. Revenue estimates also include assumptions as to how quickly taxpayers will move along this curve.[7]

A particularly difficult estimating problem involves withholding of individual income taxes under tax reform. In the past most individual taxpayers employed a process of incrementally adjusting their withholding allowances to reach a satisfactory and stable level of withholding. As a result of tax reform taxpayers must review and revise their withholding allowances by October 1, 1987. If they do not, they will face additional mandatory withholding amounts that may create a heavy penalty for misstatement. It is not possible to anticipate the kinds of responses that a massive new review will entail, so tax reform estimates continue to reflect historical patterns (see introductory text in the Appendix).

The subsequent release and modification of new withholding forms has added a further element of uncertainty to revenue estimating. Taxpayer response to these new forms will not be known for quite some time. One result will be that it will be extremely difficult to interpret collections experience for several years.

B. The "Stagger" Effect (Item I.A.1)

Faced with a phased reduction in tax rates over the next two years (the "stagger" effect"), taxpayers will defer income and accelerate deductions to minimize taxes. Nonwage personal income subject to such shifting was reviewed and net tax liability on individual tax returns for calendar year 1986 was estimated to be lower by $12 billion as a result of the stagger. Of course, calendar year 1987 (and to a lesser degree CY 1988) returns will have higher incomes and taxes as a result, but these will be taxed at lower rates. The total budget period effect of the shifting could be as high as -$3 billion. Items considered likely to be shifted are essentially discretionary items, such as charitable contributions, partnership incomes, bonuses, prepaid expenses, etc.

It should be noted that there is a limit to the extent to which shifting can occur. In many instances, the two parties to a transaction will be on opposite sides of the issue. For example taxpayers trying to accelerate deductions into 1986 may be trying to make payments to taxpayers who are themselves trying to defer income until 1987.

C. Capital Gains (Item IV.A.).

Treasury estimates of the effect on revenues from changes in the (net) tax on long-term capital gains realized by individuals include substantial behavioral responses. Faced with future capital gains rate increases, taxpayers will, in the short run, accelerate realizations; in the long run they will increase their holding periods over what they would otherwise have been. One effect of extended holding periods will be that more gains will pass into estates (and thus escape tax altogether). These effects are taken into account in the revenue estimates.

The elasticities used (relating realizations to the tax price) range from about -1 in the short run to -0.5 in the long run. On net, approximately 80% of the "static" gain in revenue from the change in tax rates applicable to long term capital gains as a result of tax reform is not included over the budget period due to behavioral changes (see Treasury Capital Gains Report).

D. State and Local Taxes (Item I.D.1.)

Treasury estimates of the revenue effect of denying or limiting the deductibility of selected state or local taxes assume that these entities will change their laws to reduce the effect on their constituents. The estimates assume that between 15% and 20% of the "static" effect of disallowing sales taxes as an itemized deduction will be lost over the five year budget period as states and localities shift to other (deductible) taxes. (See Kenyon (1986) Deductibility of State and Local Taxes).

E. Passive Losses (Item XVI.A.)

In assessing the impact of the passive loss provisions of the tax reform bill, interactions with other tax reform provisions, such as the minimum tax and the investment interest limitation, were taken into account. The estimates reflect taxpayer behavior in the following areas: a) changes in holding periods for existing investments, b) induced selling of assets, c) changed investment plans for taxpayers in the future, d) increased investment by corporations in these activities, and e) shifting from debt to equity financing (see Section IV.B. of Burman, Neubig, and Wilson (1987), this volume).

F. Corporate Minimum Tax (Item XIII.B.)

In analyzing the possible effects of the new corporate minimum tax, substantial offsets to initial static model output were made to reflect responses such as additional mergers, sales of assets, additional leasing, and changes in the discretionary elements that comprise financial statement income. The offsets represented as much as $7 billion (or two-thirds of the static $10 billion total) in 1991.

G. Limits on Consumer Interest Deductions (Item XII.A.)

Estimates of the revenue effect of proposals limiting consumer interest deductions include substantial offsets to reflect shifting of consumer portfolios towards tax-preferred assets. The prime example is increased home mortgage levels in a regime where mortgage interest on first and second homes remains deductible. The TRA '86 estimates include offsets for taxpayers who dispose of assets to pay off debt.

H. Investment in Equipment and Structures (Item II.A.)

Changes in the cost recovery rules affect the cost of capital and thereby change the relative demand for equipment and structures. To generate a more realistic portrayal of the impact on receipts of such proposals, the mix of depreciable investments was reallocated (while holding total investment constant) as a result of the proposal. Available evidence in the economics literature is limited and mixed on the extent to which this shifting would take place. For Treasury II, approximately $35 billion of investment in equipment was transferred to structures between 1986 and 1990. This represented less than 1 percent of total gross private domestic investment over the same period. The shifting is much less pronounced as a result of final tax reform provisions. (See Fullerton, Henderson, and Mackie, this volume).

I. Individual Retirement Accounts (Item XIV.A.)

Estimates of the effect of changes in the deductibility of contributions to IRAs (and the deferral element) take into account the substitutability of these for other tax-preferred savings vehicles, such as 401K plans. Roughly 20% of the disallowed IRA deductions were assumed to flow into cash or deferred accounts.

J. Bank Carrying Costs for Tax-Exempt Bond Holdings (Item IX.B.)

The extent to which revenue estimates are affected by changes in the financial behavior of taxpayers is especially apparent in provisions affecting financial institutions. The disallowance of interest deductions by banks on funds borrowed to purchase tax-exempt securities affects the behavior of banks in their role as lenders and in their role as borrowers. Because many banks will find tax-exempt securities less attractive, their demand for tax-exempt securities will be reduced. As a result of adjustments in the portfolios of the nonbank sector, more tax-exempt securities will be held directly by the nonbank sector. This reduces the taxable income of the nonbank sector thereby offsetting much of the additional tax revenue from banks created by the provision. (See Neubig and Sullivan (1987), this volume).

K. Information Reporting (Item V.C.)

The anticipated revenue gain from the information reporting requirements in tax reform includes revenue that is the direct result of document matching. In addition, the revenue estimates include amounts resulting from an expected increase in voluntary compliance (since taxpayers are aware of the new document matching possibilities and are expected to accelerate payment of tax due rather than waiting to be audited).

L. Repeal of "General Utilities" Rule (Item VI.F.)

The total revenue effect of this provision over the fiscal year 1987 - 1991 period is less than -$300 million. This relatively small amount masks large offsetting changes in corporate and individual income tax payments over the period. Some of this offset is due to the expected behavioral responses to the changed "tax prices" of completing certain distributions that were built into the estimates. These responses included estimating the number of "base-case" transactions that would take place anyway, the number of transactions that would take place with a carryover basis, and the number of transactions that would no longer occur.

M. ESOP/Estate Tax (Item XIV.C.)

The large negatives shown for this item in the Appendix table reflect the anticipated actions by taxpayers and estate executors to eliminate much of the estate tax that would otherwise be due. As a result of the newly enacted ESOP provisions, taxpayers are expected to build portfolios such that their estate can then sell eligible stock to ESOPs to obtain the estate tax deductions.

The list could be extended with other examples. However, it is not intended as a catalogue of behavioral assumptions included in estimates, but, instead, as indicative of the range and type of adjustments that are routinely considered in calculating revenue estimates.

It should be noted that the extent to which behavioral responses are included in revenue estimates depends in part on the scope of the proposal. Company-specific proposals (which include most transition rule proposals) are likely to reflect only changes in the tax accounts of the affected taxpayers. Such estimates are occasionally based on detailed information supplied by the taxpayer with no indication of alternative behavior that might be undertaken. It is also unlikely that the individual taxpayers response will have any measurable effect on economic variables (one test of when behavior should be taken into account). Estimates of proposals that affect larger aggregations of taxpayers (e.g., steel industry, farm sector) are more likely to include behavioral responses for two reasons: a) there are measurable effects and b) published studies and analysis of the effects may be available to the estimator. Finally, estimates of proposals affecting all taxable units in the economy (e.g., taxpayers, nonfilers) or overall legal forms of business (e.g., corporations, partnerships) will reflect the full range of effects that the estimator has been able to incorporate in the models.

Of course, there are several difficulties with estimating behavioral responses, the most obvious of which is the lack of data and/or the necessary empirical work to determine relevant elasticities. In other instances there may be both empirical research and theory to indicate the direction and magnitude of response to a proposal, but information on the pattern and timing of the response over the budget period is lacking. In such cases, where behavioral responses are a major element in forecasting the revenue effect of a proposal, the estimator combines any associated information with past experience and best judgment to produce an estimate.

The fact that certain aggregate economic variables are modified and others are held constant in revenue estimating is not intended to suggest that no further changes in those that are held constant are possible. It is, instead, an approach to revenue estimating which is designed to hold to a minimum the use of uncertain behavioral responses attributed to tax policy initiatives. Much of the criticism of this practice is by analysts who assume large behavioral effects that work in their preferred direction and who minimize tax effects that work in the other direction. Treasury's intent is to err, if at all, on the side of not underestimating potential deficit effects.

Finally, it should be noted with regard to all of the recent tax reform proposals, that they were not designed primarily as fiscal stimulus measures but were instead designed as efficiency and fairness measures. The changes in tax law were intended as improvements in incentives for long-term growth. Further near-term improvements in such factors as labor supply, savings and investment levels, addition of taxpayers to the tax roles, and efficiency in the use of resources were all hoped-for effects of tax reform but were not depended upon for ensuring revenue neutrality.

VI. COMMENTS ON THE ACCURACY OF THE METHODOLOGY

It is difficult, if not impossible, to directly assess the reliability of the assumptions and methods underlying revenue estimates. One needs only list possible major sources of error to sense the difficulty the analyst has in retroactively comparing actual results with projected results. These errors may occur in:

- The economic forecast.
- Determining the tax base given the economic base.
- Translating a proposal into changes in all relevant tax laws.
- Translating the changes in tax law into initial effects on the taxpayer's tax return before behavioral assumptions.
- Assumptions as to behavioral responses.
- Interactions with other tax provisions.
- Tax payment responses.
- Differences in the implementation of tax laws from initial assumptions.

A (limited) source of confidence in the methodology and assumptions used in making revenue estimates is the ability of OTA to accurately forecast total near-term tax collections. As described in Section II, receipt estimates combine both aggregate time series equations and data with revenue estimates of changes in tax law generated using the methods and principles discussed above. The resulting totals have been found to be accurate and dependable inputs for use in anticipating Federal borrowing needs over the near-term. A review of the Fiscal Year 1977 through 1987 Budgets shows that the mean error in total receipts estimates for the first fiscal year in each submission was 0.22 percent. The mean error for the second year was only 2.6 percent, despite the fact that the receipt total potentially included all sources of error mentioned above.[8]

Of course, most tax code changes have delayed effects on budget receipts, with their full impact on receipts occurring only after two or three years, so that accuracy over the short term is only indicative.

In a 1981 study of OTA's methods, the Congressional Budget Office found that, after abstracting from differences between actual economic conditions and the Administration forecast and from differences between proposed and actual tax law changes, the OTA was remarkably accurate in forecasting total budget receipts. The overall error for the 1963 - 1978 period was about 1%.[9]

As noted in Section II, OTA's general approach to forecasting income tax receipts for inclusion in the Administration's budget is to add estimates of changes in tax law to a "constant law" tax liability. This approach forces frequent reconsideration of many revenue estimates associated with tax law changes enacted after the base year, a reconsideration which includes review of all inputs to the estimates. New information, in particular the results of tax return tabulations, is thus incorporated into the estimating methodology. Similarly, the results of studies and analysis by economists in other organizations are reviewed and, when appropriate included in the revenue estimating process. This constant internal and external review serves to increase the overall accuracy of the estimates.

VII. SUMMARY

This paper has outlined some of the major elements and assumptions that go into revenue estimates. These include the role of the Administration's underlying economic forecast, the models used to determine initial revenue effects, assumed behavioral responses, items not included in estimates, and the format used to summarize the estimates, all of which are possible reasons for differences between estimates produced by different economists. The fundamental message is that there is a set of logical steps in the economic analyses underlying all revenue estimates. One of the steps is the incorporation of significant behavioral responses where economic theory and empirical evidence provide sufficient guidance to make reasonable estimates.

APPENDIX

The estimates in Table 1.1 are drawn from revenue estimates supplied to the Congressional tax writing committees by OTA on January 9, 1987. They are based on the Fiscal Year (FY) 1988 budget forecast. In general, the effects of each individual provision are estimated assuming enactment of all other provisions. Corporate provisions were estimated in the following sequence: 1) rate changes; 2) changes in credits; 3) changes in capital recovery provisions; 4) base broadeners; and 5) minimum tax provisions.

The individual estimates assume that the relationship between collections and tax liability is unchanged from current law. Fiscal year revenue effects may be significantly altered depending on the taxpayers' response to changes in withholding tables and rules governing payment of estimated taxes.

Table 1.1 **REVENUE ESTIMATES – TAX REFORM ACT OF 1986**

	Fiscal Year					Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
I. INDIVIDUAL INCOME TAX PROVISIONS						
A. Basic Rate Structure						
1. Tax rates of 15% and 28% (does not include capital gains)	-26011	-38149	-50926	-57676	-63745	-236507
2. Increase in standard deduction	-	-4433	-6449	-7004	-7566	-25452
3. Increase personal exemption to $2000 with phase-out based on taxable income	-16406	-28592	-28188	-29259	-30287	-132732
—Revise treatment of the elderly & blind	485	781	1001	1268	1581	5116
—Disallow personal exemption by new dependent filers	65	196	194	194	194	843
4. Round down inflation adjustment to $50 multiple	0	0	204	932	1471	2607
5. Repeal two-earner deduction	1500	6018	6194	6670	7138	27520
6. Repeal income averaging	450	1731	1837	1979	2115	8112
7. Interaction among individual tax provisions	-314	421	858	934	397	2296

Table 1.1 REVENUE ESTIMATES (continued)

			Fiscal Year			Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
B. Revise earned income credit, Individual[a]						
Receipts	-	-356	-852	-1054	-1279	-3541
Outlays	-52	-1535	-2649	-2719	-2764	-9719
C. Exclusions from Income						
1. Repeal partial exclusion of unemployment compensation benefits	320	1045	984	945	920	4214
2. Scholarships and fellowships	57	209	273	288	296	1123
3. Limit present law exclusion for certain prizes and awards	*	2	2	2	2	8
D. Deductions for Personal Expenditures						
1. Itemized deduction for State & local sales taxes						
Individual	794	5185	4580	4555	4681	19795
Capitalization Rule for state and local taxes						
Individual	47	119	96	78	59	399
Corporate	488	738	603	521	351	2700
2. Medical expense deduction—Increase floor under such deductions to 7.5 percent of AGI	223	1504	1590	1599	1607	6523
3. Adoption expenses repealed[b]	1	2	2	2	2	9
4. Deductibility of mortgage interest and taxes allocable to certain housing allowances	*	*	*	*	*	*
E. Expenses for Business or Investment						
1. Meals, travel, and entertainment expenses						
Restrict deduction of business meals expenses and business entertainment expenses to 80%						
Individual	367	625	700	784	857	3333
Corporate	888	1467	1615	1833	2022	7825
FICA and SECA	63	112	133	149	180	637
Limit deductions for luxury water travel						
Individual	1	3	3	3	3	13
Corporate	*	*	*	*	*	*
No deductions for educational travel						
Individual	4	13	14	14	14	59
Corporate	*	*	*	*	*	*
No deductions for investment seminars						
Individual	1	3	3	3	3	13
Corporate	*	*	*	*	*	*
Charitable Travel						
Individual	*	*	*	*	*	*
2. Employee business expenses, investment expenses and other miscellaneous itemized deductions subject to 2% floor	716	4781	4903	5354	5801	21555
3. Limit home office expense & hobby loss deductions						
Home office expenses, Individual	*	*	*	*	*	*
Hobby losses, Individual	*	*	*	*	*	*
F. Political Contributions Tax Credit Repealed	-	275	293	288	295	1151
SUBTOTAL						
Individual	-37700	-48617	-62684	-69101	-75441	-293543
Corporate	1376	2205	2218	2354	2373	10525
FICA and SECA	63	112	133	149	180	637
Outlays	-52	-1535	-2649	-2719	-2764	-9719
SUBTOTAL, INDIVIDUAL INCOME TAX	-36313	-47836	-62982	-69317	-75652	-292100

II. CAPITAL COST PROVISIONS

	1987	1988	1989	1990	1991	1987-91
A. Cost Recovery: Depreciation; ITC; Finance Leases						
1. Depreciation and expensing						
Modify Accelerated Cost Recovery System						
Individual	-617	-1220	-594	421	1943	-67
Corporate	-1727	-2179	-786	1951	6068	3327

Table 1.1 REVENUE ESTIMATES (continued)

	Fiscal Year					Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
2. Regular Investment Tax Credit						
Repeal investment tax credit effective Jan. 1, 1986						
Individual	5249	5158	5656	6098	6801	28961
Corporate	19379	17867	21865	25304	28823	113237
Reduce transition ITCs & carryforwards by 35%						
Individual	60	199	270	191	95	815
Corporate	252	1447	1624	1081	583	4987
3. Repeal finance lease rules effective January 1, 1987						
Corporate	-	121	325	436	431	1313
Limit on Business Credits (75%)						
Individual	*	*	*	*	*	*
Corporate	984	385	251	148	85	1853
15 year carryback of unused ITCs for steel						
Corporate	0	-565	23	51	82	-409
15 year carryback of unused ITCs for farmers						
Individual	0	-234	0	18	30	-186
SUBTOTAL						
Individual	4692	3903	5332	6728	8869	29523
Corporate	18888	17076	23302	28971	36072	124308
SUBTOTAL, ACRS AND ITC	23580	20978	28634	35699	44941	153831
III. ACCOUNTING ISSUES						
A. Deny the Use of the Cash Method of Accounting by Financial Institutions (Including Finance Companies)						
Corporate	395	712	762	787	484	3140
B. Simplified Dollar Value LIFO Method for Certain Small Businesses						
Individual	0	-4	-9	-9	-7	-29
Corporate	-11	-124	-212	-191	-136	-674
C. Limit Use of the Installment Method						
Deny for sales under revolving credit plan, portion of sales by dealers in personal property, sales of publicly traded property						
Individual	19	50	36	36	37	178
Corporate	1271	1663	1345	1358	1395	7032
D. Uniform Capitalization Rules						
Require capitalizing both direct and indirect production costs for manufacturing, construction, and development						
Individual	280	643	679	680	653	2935
Corporate	5947	8246	7820	6992	6608	35613
E. Disallow Reserve Method for Bad Debts Other than Selected Financial Institutions						
Individual	32	95	91	92	92	402
Corporate	992	1536	1475	1489	1491	6983
F. Repeal Election to Deduct Qualified Discount Coupons						
Corporate	0	47	37	38	39	161
G. Solvent Taxpayers Required to Recognize Income from Cancellation of Indebtedness						
Individual	2	4	3	3	2	14
Corporate	57	79	62	52	43	293
H. Conform Taxable Years of Partnerships, S Corporations, and Personal Service Corporations to Owners						
Individual	0	536	370	377	278	1561
I. Public Utility Billing Rule						
Corporate	191	356	384	387	200	1518

Table 1.1 REVENUE ESTIMATES (continued)

	Fiscal Year					Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
J. Pre-1984 Rules for Depreciation Recapture — Installment Sales of Farm Irrigation Equipment						
Individual	*	*	*	*	*	*
Corporate	*	*	*	*	*	*
K. Contributions in Aid of Construction						
Corporate	66	126	152	177	201	722
SUBTOTAL						
Individual	333	1324	1170	1179	1055	5061
Corporate	8908	12641	1825	11089	10325	54788
SUBTOTAL, ACCOUNTING ISSUES	9241	13965	12995	12268	11380	59849
IV. CAPITAL GAINS						
A. Repeal Long-term Capital Gains Exclusion for Individuals	12518	-1495	-59	3364	7442	21770
B. Corporate Capital Gains Alternate Capital Gain Rate of 34%	526	904	1034	1211	1250	4925
C. Liberalize Incentive Stock Options						
Individual	-**	-**	-**	-**	-**	-**
D. Straddles						
Individual	-	12	*	*	*	12
SUBTOTAL						
Individual	12518	-1483	-59	3364	7442	21782
Corporate	526	904	1034	1211	1250	4925
SUBTOTAL, CAPITAL GAINS	13044	-579	975	4575	8692	26707
V. COMPLIANCE AND ADMINISTRATION						
A. Increase Penalties						
Individual	49	279	376	384	393	1481
Corporate	28	76	110	112	115	441
Excise	1	8	9	10	10	38
Estate and Gift	0	5	7	7	7	26
B. IRS Interest Provisions[a]						
Individual	34	98	177	258	351	918
Corporate	65	177	303	418	554	1517
Outlays	-35	-140	-144	-111	-114	-544
C. Information Reporting						
Individual	250	763	1081	1103	1157	4354
Corporate	0	70	5	5	5	85
D. Tax Shelters						
Individual	*	*	*	*	*	*
E. Estimated Payments						
1. By Individuals (90%)						
Individual	1580	-3	48	113	86	1824
2. Tax-exempt Orgs. (Unrelated Business Income)						
Corporate	35	2	2	2	2	43
3. Private Foundations (Net Investment Income)						
Excise	125	17	5	7	10	164
F. Tax Litigation and Tax Court User Fees	*	*	*	*	*	*

Table 1.1 REVENUE ESTIMATES (continued)

	Fiscal Year					Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
G. Tax Administration Provisions						
Individual	-	-	-	-	-	-
Corporate	-	-	-	-	-	-
H. Waiver of Criminal Penalties if Voluntary Disclosure						
Individual	*	*	*	*	*	*
Corporate	*	*	*	*	*	*
I. Modify Withholding Schedules						
Individual	239	-487	-22	-20	-19	11
J. Increase in Voluntary Compliance						
Individual	58	490	693	652	668	2561
Corporate	-23	-54	-65	-66	-68	-276
SUBTOTAL						
Individual	2210	1140	2353	2490	2636	10829
Corporate	105	271	355	471	608	1810
User Fees	0	0	0	0	0	0
Excise	126	25	14	17	20	202
Estate and Gift	0	5	7	7	7	26
Outlays	-35	-140	-144	-111	-114	-544
SUBTOTAL, COMPLIANCE	2406	1301	2585	2874	3157	12323
VI. CORPORATE AND GENERAL BUSINESS TAXATION						
A. Corporate Tax Rates[c]						
Revise corporate rates and graduated structure (top rate to 34%)						
Corporate	-6629	-19092	-27562	-31760	-35189	-120232
B. Dividends Received Deduction						
Reduce corporate dividend received deduction to 80%						
Corporate	126	209	222	241	257	1055
C. Repeal $100 Dividend Exclusion for Individuals						
Individual	87	576	568	586	604	2421
D. Redemption of Stock Payments						
Repeal deductibility of "greenmail" payments						
Corporate	**	**	**	**	**	**
E. Special Limitations on Net Operating Loss Carryovers						
Corporate	9	29	39	38	29	144
F. Repeal "General Utilities" Rule						
Individual	-342	-1404	-1474	-1548	-1625	-6393
Corporate	228	1057	1336	1622	1887	6130
G. Allocation of Purchase Price in Certain Sales of Assets						
Individual	-6	-7	-7	-7	-7	-34
Corporate	71	68	85	101	114	439
H. Extraordinary Dividends Received						
Corporate	30	52	54	57	60	253
I. Repeal Various Rapid Amortization Elections						
Repeal 5 year amortization for trademark expenses						
Individual	0	3	8	15	23	49
Corporate	2	6	15	26	38	87
Amortization of railroad tunnels and bores						
Corporate	*	*	*	*	*	*
Five year write off of bus operating rights						
Corporate	-20	-	-	-	-	-20

Table 1.1 REVENUE ESTIMATES (continued)

	Fiscal Year					Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
J. Other Capital Related Costs Limit Marine CCF						
Corporate	3	4	5	6	6	24
K. Tax Regulated Investment Companies on Calendar Year Basis and Eliminate "Spillover" Dividends						
Individual	406	471	26	27	27	957
Excise	-	6	6	6	7	25
L. Mortgage-Backed Securities--REMICs						
Corporate	-2	-6	-13	-23	-32	-76
SUBTOTAL						
Individual	145	-361	-879	-927	-978	-3000
Corporate	-6182	-17673	-25819	-29692	-32830	-112196
Excise	0	6	6	6	7	25
SUBTOTAL, CORPORATE AND GENERAL BUSINESS TAXATION	-6037	-18028	-26692	-30613	-33801	-115171
VII. ENERGY, AGRICULTURE, TIMBER, AND NATURAL RESOURCES						
A. Agriculture						
1. Limit Soil and Water Conservation Expenditures and Repeal Expenditures for Clearing Land						
Individual	29	25	25	25	25	129
Corporate	15	11	11	11	11	59
2. Restrict Prepayments of Farming Expenses Over 50% of Annual Expenses						
Individual	50	5	2	2	2	61
3. Extend Scope of Expensing of Costs of Replanting						
Individual	-1	-6	-10	-13	-13	-43
Corporate	-*	-*	-*	-*	-*	-*
4. Discharge of Indebtedness Treatment of Farmers						
Individual	-9	-10	-8	-7	-5	-39
5. Capitalization of Preproductive Expenditures						
Individual	56	160	147	141	146	650
Corporate	41	61	55	53	53	263
B. Energy and Natural Resources						
1. Domestic Production						
Percentage Depletion Offset for Coal & Iron Ore Royalties Due to Deletion of Capital Gains Rates						
Individual	-7	-17	-17	-18	-19	-78
Corporate	-1	-2	-2	-2	-3	-10
Oil and Gas (except foreign IDCs)						
Individual	19	52	59	68	77	275
Corporate	56	104	125	136	118	539
Hard Minerals E&D and Percentage Depletion						
Individual	0	0	0	0	0	0
Corporate	20	30	28	27	26	131
2. Foreign Exploration & Development Costs and IDCs						
Corporate	4	6	5	5	1	21
3. Extend Energy Related Credits and Incentives at Reduced Rates						
Extend solar, geothermal, biomass, wind, and ocean credits						
Individual	-*	-*	-*	-*	-*	-*
Corporate	-380	-87	11	22	15	-419
4. Allow Residential Energy Credits to Expire						
Individual	-	-	-	-	-	-
5. Reduce Gas Exemption for Methanol to $.06						
Individual	-*	-*	-*	-*	-*	-*
Corporate	-*	-*	-*	-*	-*	-*
Excise	-*	-*	-*	-*	-*	-*

Table 1.1 REVENUE ESTIMATES (continued)

			Fiscal Year			Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
6. Deny Duty-Free Treatment to Ethyl Alcohol from CBI Unless CBI is Source						
Individual	-*	-*	-*	-*	-*	-*
Corporate	-*	-*	-*	-*	-*	-*
Excise	*	*	*	*	*	*
Customs	*	*	*	*	*	*
7. Gift & Estate Tax Deductions for Conservation Easements						
Individual	-*	-*	-*	-*	-*	-*
Estate and Gift	-*	-*	-*	-*	-*	-*
SUBTOTAL						
Individual	137	209	198	198	213	955
Corporate	-245	123	233	252	221	584
Excise	0	0	0	0	0	0
Estate and Gift	0	0	0	0	0	0
Customs	0	0	0	0	0	0
SUBTOTAL, ENERGY, AGRICULTURE, TIMBER, & NATURAL RESOURCES	-108	332	431	450	434	1539
VIII. EMPLOYMENT AND EXCISE TAXES						
A. Employment Taxes						
Ministerial Reelection into FICA						
FICA	*	*	*	*	*	*
FUTA for Indian Tribes	-*	-*	-	-	-	-
B. Excise Taxes						
Medivac Helicopters						
Excise	-*	-*	-*	-*	-*	-*
SUBTOTAL						
Individual	0	0	0	0	0	0
Excise	0	0	0	0	0	0
FICA	0	0	0	0	0	0
FUTA	0	0	0	0	0	0
SUBTOTAL, EMPLOYMENT AND EXCISE TAXES	*	*	*	*	*	*
IX. FINANCIAL INSTITUTIONS						
A. Reserve for Bad Debts						
1. Commercial banks, Corporate	195	560	878	1163	588	3384
2. Thrift institutions, Corporate	60	90	100	110	130	490
B. Interest On Debt to Purchase Or Carry Tax-exempt Obligations						
Individual	-56	-299	-676	-1059	-1448	-3538
Corporate	85	384	776	1156	1535	3936
C. Allow NOL's of Thrifts to Eight Year Carryforward						
Corporate	0	-60	-100	-100	-80	-340
D. Reorganizations of Financially Troubled Thrifts						
Corporate	0	0	50	100	160	310
E. Losses on Deposits in Insolvent Financial Institutions						
Individual	-3	-1	-1	-1	-1	-7
SUBTOTAL						
Individual	-59	-300	-677	-1060	-1449	-3545
Corporate	340	974	1704	2429	2333	7780
SUBTOTAL, FINANCIAL INSTITUTIONS	281	674	1027	1369	884	4235

Table 1.1 REVENUE ESTIMATES (continued)

			Fiscal Year			Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
X. FOREIGN TAX PROVISIONS						
A. Foreign Tax Credits						
Separate Foreign Tax Limitations						
Corporate	279	445	430	457	488	2099
Credit for high withholding taxes on interest						
Corporate	111	174	158	258	409	1110
Treatment of losses						
Corporate	9	21	24	25	27	106
Deemed-paid credit						
Corporate	6	20	61	88	99	274
B. Source Rules						
Sales of inventory and property						
Corporate	*	*	*	*	*	*
Transportation income						
Corporate	8	16	19	25	31	99
Dividends and interest of 80/20's						
Corporate	*	*	*	*	*	*
Allocation of interest expenses						
Corporate	143	381	602	820	1002	2948
Allocation of expenses other than interest and R&D						
Corporate	58	92	97	102	107	456
C. Foreign Corporations of U.S. Taxpayers						
Expand subpart F income						
Corporate	110	184	179	196	216	885
De minimis tax have income rule						
Corporate	40	67	68	77	81	333
Use of deficits in E&P						
Corporate	14	22	22	26	27	111
D. Special Tax Provisions						
Possesions tax credit						
Corporate	42	69	68	75	82	336
Transfers of intangibles						
Corporate	24	60	83	110	140	417
Foreign investment companies						
Corporate	10	17	16	19	21	83
E. Foreign Taxpayers						
Branch level tax						
Corporate	*	*	*	*	*	*
Insurance: capative insurance companies						
Corporate	25	64	88	115	146	438
Income of foreign governments						
Corporate	23	44	49	55	60	231
Dual residence companies						
Corporate	73	126	132	140	151	622
F. Foreign Currency Exchange Gains and Losses						
Corporate	*	*	*	*	*	*
G. Reduce Section 911 Exclusion to $70,000						
Individual	23	44	49	55	60	231
SUBTOTAL						
Individual	23	44	49	55	60	231
Corporate	975	1802	2096	2588	3087	10548
SUBTOTAL, FOREIGN TAX PROVISIONS	998	1846	2145	2643	3147	10779
XI. INSURANCE PRODUCTS AND COMPANIES						
A. Life Insurance Products and Companies						
Repeal $1,000.00 exclusion of interest income on death benefits						
Individual	*	*	*	*	*	*

Table 1.1 REVENUE ESTIMATES (continued)

			Fiscal Year			Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
Allow NOLs for one insolvent life insurance company to offset distributions from policyholder surplus accounts						
Corporate	-*	-*	-*	-*	-*	-*
Tax Blue Cross-Blue Shield and certain other tax-exempt insurance companies under special tax rules						
Corporate	88	162	193	187	176	806
Tax structured settlement company investment income (except for settlements arising out of physical injury or sickness)						
Corporate	*	*	*	*	*	*
Repeal 20% life insurance company deduction						
Corporate	393	699	751	807	864	3514
Exempt certain burial insurance contracts from the statutory definition of life insurance						
Individual	-*	-*	-*	-*	-*	-**
Disallow deductions for interest payments on certain corporate policyholder loans						
Corporate	*	*	*	*	*	*
Disallow deductions for certain insured losses						
Corporate	*	*	*	*	*	*
B. Property and Casualty Insurance Companies						
Include 20% of annual increase in unearned premium reserves as taxable income (10% for bond insurance)						
Corporate	230	318	255	234	245	1282
Include 20% of existing unearned premuim reserve as taxable income (10% for bond insurance income) over next 6 years						
Corporate	254	432	469	512	495	2162
Reduce deductions for losses incurred by a specified proportion of tax-exempt interest & dividends received						
Corporate	19	74	156	258	358	865
Pretax discounting of loss reserves						
Corporate	374	667	757	714	566	3078
Repeal protection against loss account						
Corporate	58	76	68	44	24	270
Adopt single, small company provision						
Corporate	-14	-33	-27	-25	-24	-123
SUBTOTAL						
Individual	0	0	0	0	0	0
Corporate	1402	2395	2622	2731	2704	11854
SUBTOTAL, INSURANCE PRODUCTS & COMPANIES	1402	2395	2622	2731	2704	11854
XII. INTEREST EXPENSE						
A. Nonbusiness Interest Limits						
Disallow consumer interest						
Individual	1095	2785	4056	5161	6056	19153
Limit investment interest						
Individual	145	351	495	638	768	2397
B. Disallow deduction for interest to fund IRA's						
Individual	*	*	*	*	*	*
SUBTOTAL						
Individual	1240	3136	4551	5799	6824	21550
SUBTOTAL, INTEREST EXPENSES	1240	3136	4551	5799	6824	21550
XIII. MINIMUM TAX						
A. Individual Minimum Tax (21%)						
Individual	1377	3656	948	-487	-1016	4478

Table 1.1 REVENUE ESTIMATES (continued)

			Fiscal Year			Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
B. Corporate Minimum Tax (20%)[d]						
Corporate	2717	4649	4760	4225	3532	19883
SUBTOTAL						
Individual	1377	3656	948	-487	-1016	4478
Corporate	2717	4649	4760	4225	3532	19883
SUBTOTAL, MINIMUM TAX	4094	8305	5708	3738	2516	24361
XIV. PENSIONS AND EMPLOYEE BENEFITS						
A. Pensions						
Limit IRA deduction for individuals not covered by retirement plans						
Individual	211	4758	4576	4609	4797	18951
Limit deferrals of employee cash or deferred arrangements, and tax-sheltered annuities to $7000. Additional $2500 deferral if invest in employer securities						
Individual	276	393	491	614	768	2542
Apply nondiscrimination tests of CODA's to all employer matching contributions						
Individual	**	**	**	**	**	**
Permit tax-exempt employers to maintain CODA's						
Individual	-**	-**	-**	-**	-**	-**
Modify coverage tests and vesting requirements of qualified plans						
Individual	**	**	**	**	**	**
10% additional income tax on early withdrawls						
Individual	499	263	231	259	290	1542
Replace 10 year averaging with 5 year treatment						
Individual	95	277	211	284	344	1211
Define normal retirement age as social security age and adjust early retirement assumption						
Individual	600	900	1000	1200	1343	5043
Delay indexing of dollar limits to defined contribution plans						
Individual	0	1	2	4	5	12
10% excise on qualified plan reversions						
Excise	250	125	20	20	20	435
Phase out 3 year recovery rule						
Individual	1899	2100	1977	2049	2050	10075
Special rules for Simplified Employee Plans						
Individual	-15	-35	-40	-45	-50	-185
B. Employee Benefits						
Exclude educational assistance with cap						
Individual	-126	-38	-	-	-	-164
FICA	-69	20	-	-	-	-89
Exclude group legal benefits						
Individual	-109	-38	-	-	-	-147
FICA	-42	-10	-	-	-	-52
Exclude campus lodging						
Individual	-*	-*	-*	-*	-*	-*
Allow self-employed to deduct 25% of health insurance premiums						
Individual	-126	-244	-307	-114	-	-791
Modify non-discrimination tests for health plans, group-term life insurance, and establish uniform definition of highly compensated employees						
Individual	-	75	132	144	156	507
Modify tangible prizes and awards treatment						
Individual	-17	-48	-51	-53	-56	-225
Modify accrued vacation pay						
Individual	5	8	2	2	2	19
Corporate	80	59	16	17	14	187

Table 1.1 REVENUE ESTIMATES (continued)

			Fiscal Year			Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
C. Employee Stock Ownership Plans (ESOP's)						
Repeal present law effective January 1, 1987						
Corporate	1220	1055	408	215	80	2978
Non-credit ESOP changes						
Corporate	-140	-188	-248	-293	-338	-1207
Estate and Gift	-666	-646	-1239	-1890	-2581	-7022
SUBTOTAL						
Individual	3192	8372	8224	8953	9649	38390
Corporate	1160	926	176	-61	-244	1958
Excise	250	125	20	20	20	435
FICA	-111	-30	0	0	0	-141
Estate and Gift	-666	-646	-1239	-1890	-2581	-7022
SUBTOTAL, PENSIONS AND EMPLOYEE BENEFITS	3825	8747	7181	7022	6844	33620
XV. RESEARCH AND DEVELOPMENT PROVISIONS						
A. Extend & Modify R&D Credit Thru 1988 at 20% Rate (Increase incentives for university research)						
Individual	-17	-15	-12	-6	-3	-53
Corporate	-1383	-1072	-739	-399	-245	-3838
B. Adopt Rule for Allocating R&D Expenditures Between U.S. and Foreign Income						
Corporate	-257	-138	0	0	0	-395
C. Exception for Personal Holding Company Rules in Developing Computer Software						
Corporate	-40	-10	-9	-7	-6	-72
D. Augmented charitable deduction for the donation of scientific equipment						
Corporate	*	*	*	*	*	*
SUBTOTAL						
Individual	-17	-15	-12	-6	-3	-53
Corporate	-1680	-1220	-748	-406	-251	-4305
SUBTOTAL, R & D PROVISIONS	-1697	-1235	-760	-412	-254	-4358
XVI. TAX SHELTERS AND REAL ESTATE						
A. Tax Shelters						
Limit Nonparticipatory Losses & Credits (Passive Losses)						
Individual	841	3486	5856	8274	10352	28809
Corporate	-40	-269	-707	-1134	-1636	-3786
B. Real Estate						
1. At-risk Rules Extended to Real Estate (Except third party non-recourse debt)						
Individual	*	*	*	*	*	*
2. 20% Credit for Historic Structures and 10% Credit for Other Rehabilitation Expenditures						
Individual	61	222	343	410	472	1508
Corporate	42	122	174	205	232	775
3. New Credit for Low Income Rental Housing						
Individual	-80	-297	-535	-707	-798	-2417
Corporate	-7	-26	-47	-62	-71	-213
4. Modify Taxation of Real Estate Investment Trusts						
Corporate	20	17	-8	-11	-14	4
SUBTOTAL						
Individual	822	3411	5664	7977	10026	27900
Corporate	15	-156	-588	-1002	-1489	-3220
SUBTOTAL, TAX SHELTERS AND REAL ESTATE	837	3255	5076	6975	8537	24680

Table 1.1 REVENUE ESTIMATES (continued)

	Fiscal Year					Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
XVII. TAX-EXEMPT BONDS						
A. Restrict arbitrage and limit nongovernmental use						
Individual	173	596	922	1181	1427	4299
Corporate	299	521	481	350	193	1844
B. Modify Refunding Rules for Tax-Exempt Bonds						
Individual	14	70	167	270	342	863
Corporate	*	*	*	*	*	*
C. Extend Information Reporting Requirements to all tax-exempt bonds						
Individual	*	*	*	*	*	*
Corporate	*	*	*	*	*	*
SUBTOTAL						
Individual	187	666	1089	1451	1769	5162
Corporate	299	521	481	350	193	1844
SUBTOTAL, TAX-EXEMPT BONDS	486	1187	1570	1801	1962	7006
XVIII. TAXATION OF TRUSTS, ESTATES, AND MINOR CHILDREN						
A. Unearned Income of Children Under Age 14 Tax unearned income of children under age 14 at parent's top marginal rate						
Individual	92	254	208	224	234	1012
B. Compress Present Law Rate Schedule for Income						
Estates						
Individual	5	21	32	34	35	127
Trusts						
Individual	30	124	194	203	214	765
C. Modified Taxation of Grantor Trusts						
Individual	**	**	**	**	**	100
D. Generation-skipping Transfer Tax						
Estate and Gift	-*	-*	-*	-*	-*	-*
E. Shorten Holding Period for Special Recapture Tax on Heirs						
Individual	*	*	*	*	*	*
F. Extension of Time to Supply Information on Certain Estate Tax Returns						
Individual	-*	-*	-*	-*	-*	-*
G. Decrease Period of Tax Deferral for Trusts						
Individual	1150	128	133	135	137	1683
H. Payment of Income Taxes of Estates						
Individual	361	257	29	31	32	710
SUBTOTAL						
Individual	1638	784	596	627	652	4297
Estate and Gift	0	0	0	0	0	
SUBTOTAL, TAXATION OF TRUSTS AND ESTATES	1638	784	596	627	652	4297
XIX. MISCELLANEOUS PROVISIONS						
A. Extend/Modify Targeted Jobs Credits for 3 Years (40% rate for first year employment and no credit for second year employment)						
Individual	-22	-36	-39	-23	-14	-134
Corporate	-145	-240	-198	-111	-58	-752

Table 1.1 REVENUE ESTIMATES (continued)

			Fiscal Year			Total
	1987	1988	1989	1990	1991	1987-91
			($ Millions)			
B. Extend Expensing Costs for Removing Barriers to Handicapped						
Individual	-2	-1	-1	-1	-2	-7
Corporate	-21	-12	-14	-16	-18	-81
C. Tax Relief for Vietnam MIA Spouses						
Individual	-*	-*	-*	-*	-*	-*
D. Exempt and Nonprofit Organizations						
Rentals of membership lists						
Corporate	-4	-8	-7	-8	-9	-36
Tax exemption for certain title holding companies						
Individual	-2	-7	-11	-19	-29	-68
Corporate	-3	-13	-22	-36	-57	-131
Exempt trade show income						
Corporate	-4	-8	-12	-16	-22	-62
Exception to membership organization deduction rules						
Corporate	0	-*	-*	-*	-*	-*
Excise	0	-*	-*	-*	-*	-*
Tax-exempt status for technology transfer organization						
Corporation	-*	-*	-*	-*	-*	-*
Distribution of Low-Cost Articles by Charities						
Corporation	-	-*	-*	-*	-*	-*
E. Diesel Tax at Wholesale Level						
Excise	5	*	*	*	*	5
F. Allocation of Co-op Housing Interest and Taxes						
Corporate	-*	-*	-*	-*	-*	-*
G. Change in Gasoline Excise Tax						
Individual	-	-12	-19	-19	-19	-69
Corporate	-	-2	-3	-3	-3	-11
Excise	-	300	200	200	200	900
H. Foster Care Payment						
Individual	-5	-8	-9	-11	-12	-45
I. Reindeer Related Income						
Individual	-*	-*	-*	-*	-*	-*
J. Treatment of Certain Technical Personnel						
Individual	-*	-*	-*	-*	-*	-*
FICA	*	*	*	*	*	*
SECA	-*	-*	-*	-*	-*	-*
FUTA	*	*	*	*	*	*
SUBTOTAL						
Individual	-31	-64	-79	-73	-76	-323
Corporate	-177	-283	-256	-190	-167	-1073
Excise	5	300	200	200	200	905
FICA	-*	-*	-*	-*	-*	-*
SECA	-*	-*	-*	-*	-*	-*
FUTA	-*	-*	-*	-*	-*	-*
SUBTOTAL, MISCELLANEOUS PROVISIONS	-203	-47	-135	-63	-43	-491
XX. TECHNICAL CORRECTIONS TO RECENTLY ENACTED LEGISLATION						
SUBTOTAL						
Individual	-	-	-	-	-	-
Corporate	-175	-	-	-	-	-175
Customs	-	-	-	-	-	-
Excise	-	-	-	-	-	-
Estate and Gift	-	-	-	-	-	-
FICA	-	-	-	-	-	-
FUTA	-	-	-	-	-	-
SECA	-	-	-	-	-	-

Table 1.1 REVENUE ESTIMATES (continued)

	Fiscal Year 1987	1988	1989 ($ Millions)	1990	1991	Total 1987-91
SUBTOTAL, TECHNICAL CORRECTIONS	-175	-	-	-	-	-175
SUMMARY, TAX REFORM ACT OF 1986, BY SOURCE OF ESTIMATED REVENUE:						
TOTALS:						
Individual	-9294	-24196	-34216	-32833	-29768	-130306
Corporate	28252	25155	23395	25320	27717	129838
Excise	381	456	240	243	247	1567
Customs	0	0	0	0	0	0
Estate and Gift	-666	-641	-1232	-1883	-2574	-6996
FICA and SECA	-48	82	133	149	180	496
FUTA	0	0	0	0	0	0
Outlays	-87	-1675	-2793	-2830	-2878	-10263
TOTAL UNIFIED BUDGET EFFECT	18538	-819	-14473	-11834	-7076	-15664
Less Outlays	-87	-1675	-2793	-2830	-2878	-10263
TOTAL UNIFIED BUDGET RECEIPTS EFFECT	18625	856	-11680	-9004	-4198	-5401

Notes:

Five year (1987-1991) totals may not add due to rounding.
* = less than $5 million
** = less than $50 million
-* = loss less than $5 million
0 indicates a rounded number greater than zero but less than $50 million
- indicates orginal entry is zero

[a] Outlays shown as negatives.

[b] A direct expenditure program under Social Security is expected to offset the revenue increases.

[c] Does not include the Blue Cross/Blue Shield effect, which is included in a separate provision.

[d] Does not include any effect of Tax Reform on corporate estimated payments made during FY 1986.

FOOTNOTES

[1] *Tax Reform for Fairness, Simplicity, and Economic Growth, Volume 1: Overview*, November, 1984, U.S. Department of the Treasury, pp. 245-254.

[2] *The President's Tax Proposals to the Congress for Fairness, Growth, and Simplicity*, The White House, May, 1985, pp. 453-461.

[3] *Budget of the United States Government for FY 1988: Supplement*, The Office of Management and Budget, January, 1987, pp. 4-15 - 4-17.

[4] For an example see *The Tax Reform Act of 1986, Conference Report*, Volume II, pp. II-861,II-885.

[5] Much of the criticism of the "static" nature of revenue estimates—in the sense that they were assumed to exclude taxpayer responses to changes in tax law—was published in news media editorials and letters during the course of the tax reform debates. For example, see the April 3-15, 1985 series of Wall Street Journal editorials on reform referring to the static nature of Treasury estimates.

[6] The baseline forecast, which is generated by the Council of Economic Advisors, is grounded in the quarterly econometric model created by the Bureau of Economic Analysis. Deviations from the model output occur as the initial forecast is reviewed and revised by the Treasury Department, the Office of Management and Budget. and the Council of Economic Advisors. The most recent version of the model is described in *The BEA Quarterly Econometric Model of the U.S. Economy*: 1985 Version, Bureau of Economic Analysis Staff Paper 44, U.S. Department of Commerce, July, 1986.

[7] A major problem for revenue estimators is that the revised withholding tables that would normally accompany changes individual income taxes are almost never available until long after the revenue estimate is made. Initial estimates of provisions subject to withholding must therefore be made assuming that historical patterns continue to hold. This is the fundamental reason for Note B in the attached table of revenue estimates (to the effect that the estimates assume that the relationship between collections and tax liability is unchanged from current law). In fact, if withholding more closely mirrors actual liabilities, an element of interest free borrowing from taxpayers will be reduced.

Based on internal tabulations, aggregate (historical) "rules-of-thumb" for translating changes in liability to changes in payments of income taxes are listed below. These ratios show the fraction of a change in calendar year liability that will show up as a change in collections for the same fiscal year and for the next fiscal year. Users should note that the ratios are intended as guides only, that they imply a "normal" pattern of economic activity during the course of a year and that they exclude "startup" effects of changes in law (which are often quite different).

		FY	*FY+1*
		(percentages)	
Individuals:	Proposals to change tax rates	55	45
	Proposals to change business income	37.5	62.5
	Proposals to change minimum taxes:		
	Pre-tax reform	0	100
	Post-tax reform	33	67
Corporations:	Proposals other than minimum tax	60	40
	Proposals to change minimum tax:		
	Pre-tax reform	0	100
	Post-tax reform	60	40

[8] Source, unpublished OTA data.

[9] A *Review of the Accuracy of Treasury Revenue Forecasts*, 1963-1978, Staff Working Paper, Congressional Budget Office, February 1981.

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U. S. Department of the Treasury, Office of Tax Analysis. *Report to Congress on the Capital Gains Tax Reductions of 1978*, Washington, DC: Government Printing Office, 1985.

2 THE INDIVIDUAL INCOME TAX SIMULATION MODEL

James M. Cilke and Roy A. Wyscarver

I. INTRODUCTION

The staff of the Office of Tax Analysis (OTA) has the dual responsibility of projecting estimates of Federal income tax receipts and of analyzing and estimating the revenue, distributional, and economic impact of enacted and proposed legislation. One of the most useful tools employed by OTA to estimate and evaluate individual income taxes is the individual income tax simulation model.

Over the last four years, the model was used to estimate the effects of thousands of proposed changes to the tax code that arose during the course of the tax reform initiative. The tax model was used to analyze and estimate:

- Effects of a single tax provision or set of provisions,
- Separate effects of the components of a set of multiple provisions,
- Interaction among provisions,
- Sensitivity of the tax system to certain tax parameters,
- Average marginal tax rates,
- Effects of behavioral responses in certain instances,
- Distributional effects of the proposed tax system, and
- Effects of a proposal in terms of who gains and who loses.

Moreover, the model provided these analyses on a tax return or a family basis; distributed by adjusted gross income, economic income, or some other income concept; and including or excluding the non-filing population.

Last, but not least, the model allowed the analysis and estimation of proposals for fundamental tax reform; proposals that required information which was not tied to a particular tax law or limited to what was reported on tax returns filed under that tax regime.

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The individual income tax model consists of two major components: (a) a probability sample of individual income tax returns merged with other demographic and economic data and (b) a computer program that manipulates the sample, according to a set of input parameters that define the tax laws, for the analysis of enacted and proposed legislation. The tax model is a microsimulation model, and works by recalculating the Federal individual tax liability for each return in the sample. The effects of changes in tax laws can be simulated by changing the set of parameters or computer coding that define the tax laws.

The construction of the data component of the tax model is described in Section II of this paper. The data base was constructed by merging tax return data from the Statistics of Income (SOI) file with other demographic and economic data from the Current Population Survey (CPS) file, imputing additional information not available on either file, and extrapolating the data through a five year budget period.

The other component of the tax model, the computer program, is described in Section III. The computer program consists of three sets of instructions. The first set of instructions reads input parameters that contain changes to (a) tax parameters affecting capital gains, exemptions, credits, etc.; (b) parameters affecting the definition of itemized deductions; and (c) the tax rate schedules. These parameters collectively define the tax laws that are applied in the second set of instructions. The second set of instructions sequentially reads income tax returns from the data base, recalculates tax liability under the tax laws, and computes the change between the base law and the proposed law. Updates to aggregate tabulations are performed on either a return or family basis and retained for the final set of instructions. The last set of instructions prints the results of the simulation in a tabular format. A more detailed description of Sections II and III can be found in the individual tax model documentation.[1]

Section IV describes how the tax model was used to answer various kinds of tax policy questions during tax reform. This section also summarizes some of the quantitative results and their qualitative significance. Presented here are estimates of average marginal tax rates weighted by selected income sources under 1980 law, 1986 law, and tax reform. Also presented here is a table showing the distribution of gainers and losers from the Tax Reform Act of 1986.

Finally, Section V outlines and discusses additional developments that are needed to further improve the accuracy and usefulness of the tax model. Of particular importance is the need to more reliably extrapolate the data file to future years.

II. DESCRIPTION OF THE TAX REFORM DATA BASE

The increasing sophistication of tax proposals and analysis has gradually outdated the use of aggregate data. Distributional effects of tax changes are important in the assessment of the probable and overall impact of any proposal and have always been a factor in assessing individual income tax proposals. These distributional effects can best be estimated through the use of a microdata file. In addition, Federal individual income taxes are so complex that estimates of many interacting variables (necessary for the assessment of the effects of proposed changes in the tax code) cannot be handled in the aggregate. To capture these effects in our analyses, OTA develops and maintains a microdata file representative of the filing and non-filing U.S. population.

The basic data in the tax model's data base comes from information reported on individual tax returns. However, this information proved to be inadequate for analyzing many of the fundamental tax reform proposals offered in the early 1980's. Therefore, OTA expanded the tax return based data file by adding information such as non-taxed income sources, consumption, and wealth. The tax reform data base was constructed through four processes.

- Preparation of tax return data from the Statistics of Income (SOI) and demographic and economic data from the Current Population Survey (CPS) file,
- Merging the SOI and CPS files,
- Imputing additional information not available on either file, and
- Extrapolating the data through a five year budget period.

In the first process, considerable preparatory work was required to ensure that the SOI and CPS files were consistent with each other and representative of the U.S. population. This process is outlined for each file in Subsection A.

The second process, merging the SOI and CPS data files, is the topic of Subsection B. The merge process expands the data base to include forms of income that are not presently taxed, primarily, transfer payments; to incorporate non-filers, families and single individuals who do not file tax returns (largely because their incomes are too low); to combine taxpayers into families; and to unite dependent filers with their corresponding family.

Imputing additional information is covered in Subsection C. This additional information, when combined with the SOI and CPS data, allows for the construction of a measure of "economic income."

Subsection D covers the final process, the extrapolation of the data through a five year budget period. This extrapolation was necessary to provide to policymakers estimates of the revenue effects of tax law changes over the five year period immediately following enactment.

A. Preparation for the Merge

1. SOI Preparation

The starting point for developing the tax reform data base was a stratified random sample of approximately 144,000 tax returns filed for calendar year

1981. This was the same sample employed by the Internal Revenue Service (IRS) to produce the tabulations published in the Statistics of Income – 1981 Individual Income Tax Returns.[2] The data on each tax return in the sample include the major entries on Form 1040, 1040A, and the auxiliary schedules. When weighted, these data represent the U.S. aggregate population of taxpayers.

a. Appending Social Security Data

The first enhancement made to the data base was the appending of Social Security Administration (SSA) data on age, sex, and social security earnings of the taxpayer(s). This was accomplished by providing SSA with the social security numbers (SSNs) of the taxpayers in the SOI sample. SSA used the SSNs to extract the requested data from its master file. OTA then merged the extracted data with the SOI sample.

b. Reducing the Sample Size

The use of large samples for microsimulation is computationally expensive. One way to limit this expense is to reduce the size of the sample. This approach, however, may result in a reduced sample that no longer accurately represents the population. Therefore, the objective is to reduce the size of the sample while minimizing the distortion this reduction introduces.

The usual methods for reducing a data file are variants of stratified and clustered sampling. Yet sampling theory does not provide error estimates for many of the distributional questions that are of concern in formulating tax policy. OTA used a deterministic optimization model that endeavored to maintain the characteristics of the enhanced 1981 SOI as closely as possible.

The optimization model was an optimal cluster analysis procedure that employed Lagrangian relaxation, an efficient variation of the K-median algorithm and dynamic programming search algorithms.[3] The objective of this procedure was to select "the" subset of points (75,422 observations) out of the original sample of 144,322 observations so as to minimize the total loss of information as measured by an explicit objective function.

Since this technique requires the computation of an information loss for every possible pairing of observations in the original sample, solving the total problem would involve 20.7 billion variables ($144{,}000^2$); an impossibility on conventional computers.

An obvious solution would be to decompose the total problem into relatively independent subproblems that could be solved separately. However, none of the many existing methods for decomposing a large scale optimization problem was applicable to the SOI reduction because of its enormous size. Therefore, a "heuristic" was employed for subdividing the aggregate problem into manageable pieces. The heuristic was similar to the formulation of strata boundaries for stratified sampling.

Table 2.1 **Essential Attributes Preserved In Reducing the 1981 SOI File**

Adjusted gross income or loss
Taxes paid Wages and salaries
Dividend income
Interest income
Business income or loss
Farm income or loss
Capital gains or losses
Total tax credits
Pension and annuity income
Itemized deductions
Total tax preference income

For simplicity, twenty subproblems were generated according to the strata boundaries defined by IRS, i.e., the presence of business/non-business activity stratified by adjusted gross income or largest single income item. One subproblem was constructed solely for returns with farm income or loss since this attribute was very sparse in the other subproblems. The two remaining subproblems consisted of individual taxpayers who filed singly and everyone else. Thus, the aggregate problem was divided into twenty-three subproblems and each subproblem was solved separately.

Before actually solving each subproblem, the staff of OTA selected the twelve items in Table 2.1 as essential attributes to be preserved in the reduced SOI sample. Summary statistics–aggregate total, mean, standard deviation, and coefficient of variation–were computed before and after the reduction for each subproblem. Analysis of these statistics revealed that the smallest percentage deviations between the full and reduced sample occurred when adjusted gross income (AGI), taxes paid (TP), and business income/loss (BI) were included in the objective function. The inclusion of additional attributes in the objective function produced summary statistics that were generally, but not always, better than the results obtained when the additional attributes were excluded. Although including additional attributes improved the result, this gain was often offset by a degradation in computational efficiency.

The objective function used in the optimization model measured the loss of information via the functional relationship below:

$$L_{ij} = [(AGI_i - AGI_j)^2 + (TP_i - TP_j)^2 + (BI_i - BI_j)^2] \qquad (2.1)$$

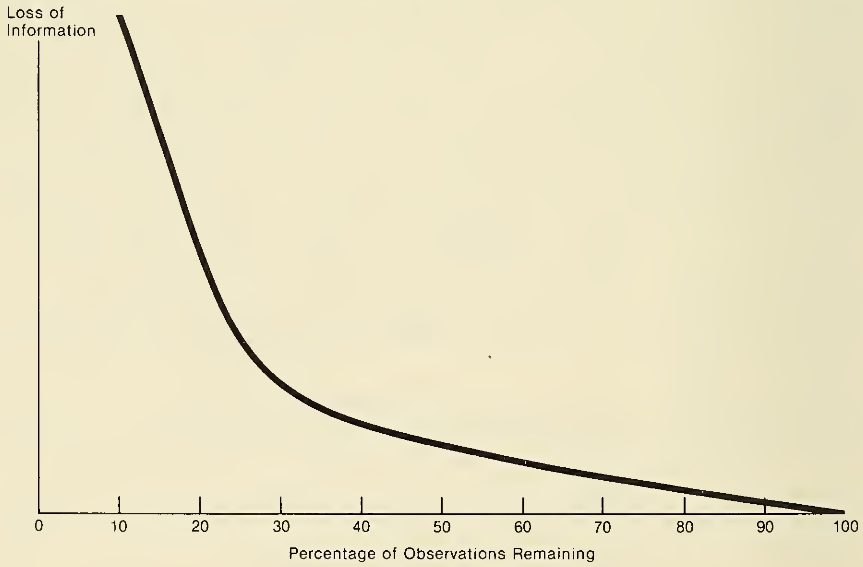
Where i is a point in the original SOI sample.
j is a point in the reduced SOI sample.
L_{ij} is the loss that results from letting point j represent point i.

AGI_i is adjusted gross income for point i.
AGI_j is adjusted gross income for point j.
TP_i is taxes paid for point i.
TP_j is taxes paid for point j.
BI_i is business income/loss for point i.
BI_j is business income/loss for point j.

Figure 2.1 presents a graphical representation of a typical loss function. The loss function in equation (1) does not in and of itself guarantee that the twelve attributes in Table 2.1 will be preserved. However, the aggregate amounts, standard deviation, and coefficient of variation for these attributes are well preserved because the attributes not specifically included in the loss function are highly correlated with either AGI or taxes paid.

The number of returns retained in each of the twenty-three subproblems was determined on a case-by-case basis. In general, the subproblems were reduced in size until the loss function yielded an information loss which was less than or equal to an arbitrary standard. However, no subproblem was allowed to go below the 20 percent retention level because this produced unacceptable information losses. Further, the weight per observation was not allowed to exceed a trigger weight, so that no single observation represents an unusually large portion of the population. All subsequent steps in forming the tax reform data base were made to this reduced SOI sample.

Figure 2.1 **A Typical Loss Function**



c. Imputing Itemized Deductions and Other Data

The first actual modifications to the data base were the imputations of itemized deductions for non-itemizers and the lesser earning spouse's share of wage and salary income. The former imputation was required in order to analyze tax proposals that treat itemized deductions differently from present law, and the latter was required to simulate the deduction for married couples enacted in the Economic Recovery Tax Act of 1981. Itemized deductions were imputed to non-itemizers by analyzing 1981 tax returns that itemized, and the share of wage and salary income was imputed by analyzing 1980 CPS data.

d. Extrapolating the Data to 1983

The second modification was a statistical extrapolation or "aging" of the data base to 1983 levels of income and deductions. The extrapolation process consisted of two stages. The first stage was designed to reflect uniform growth and inflation, and was accomplished by imposing constant weight changes and proportional increases in all the dollar amounts in the data base. The second stage reflected more complicated trends superimposed on the uniform growth, and was achieved by adjusting only the weights of each return to meet target amounts for a set of selected variables. The net effect of this process ensured that the levels of income, deductions, credits, and exemptions were consistent with aggregate economic measures such as components of national income, inflation, employment, and population. The following subsections describe the extrapolation in further detail.

For the liability year 1983, OTA projected 96.7 million returns with total adjusted gross income of $1,997 billion. The 1983 file reflects these estimates. OTA also developed projections of several sources of income and other aggregates, as well as the distribution of AGI by broad AGI classes, and are reflected in the 1983 file. These estimates or "targets" are presented in Table 2.2.

The twenty-three targets were developed by Office of Tax Analysis staff using time series techniques, including regressions of aggregate Statistics of Income data against data from the National Income and Product Accounts. The targets were intended to be consistent with the short-range economic forecasts underlying the federal budget for fiscal 1984.

In choosing the items for which targets were needed, OTA relied on intuition and experience. In general, an item was not targeted unless time series techniques seemed likely to give a better projection than the first-stage extrapolation described below.

Stage I of the Extrapolation to 1983. The first step in the extrapolation process was designed to reach the targets for number of returns by filing status and for total adjusted gross income. This step consisted of simply multiplying the sample weight of each return by a factor based on filing status and multiplying every dollar amount (except itemized deductions) on each return by a second factor which was the same for all returns. The weight

Table 2.2 **Targets for the Extrapolated 1983 Tax Model**

Description	Target (Millions)
$ AGI < $ 0	-25,000
$ 0 <= AGI < $ 5,000	45,552
$ 5,000 <= AGI < $ 10,000	127,565
$ 10,000 <= AGI < $ 15,000	177,933
$ 15,000 <= AGI < $ 20,000	194,184
$ 20,000 <= AGI < $ 30,000	419,624
$ 30,000 <= AGI < $ 50,000	603,675
$ 50,000 <= AGI < $ 100,000	282,210
$ 100,000 <= AGI < $ 200,000	87,756
AGI of $ 200,000 & Over	83,901
Number of single returns	41.0
Number of joint returns	46.1
Number of married-separate or surviving-spouse returns	1.3
Number of head-of-household returns	8.3
Number of taxpayer and dependent exemptions	219.6
Number of aged and blind exemptions	15.1
Pensions in adjusted gross income	65,300.0
Net capital gains in adjusted gross income	36,900.0
Dividends in adjusted gross income (1979 Law)	52,400.0
Interest in adjusted gross income (1979 Law)	166,700.0
Wages & Salaries in adjusted gross income	1,660,100.0
Earned income credit	1,620.0
Investment tax credit	4,140.0

factors were chosen to reach targets for the number of returns by filing status. Once these targets were achieved, the dollar-amount factor was chosen to reach the target for total adjusted gross income.

The dollar amounts of itemized deductions were adjusted separately by multiplying each deduction type by its own growth factor. In addition. extraordinary growth or legislation required that four tax credits be adjusted exogenously: (a) the child care credit, (b) the elderly credit, (c) the foreign tax credit, and (d) the jobs tax credit. These changes achieved the targets for number of returns by filing status. aggregate AGI, itemized deductions. the four tax credits. and brought all other aggregates into a more plausible range, so that fewer iterations would be required in the second stage of the extrapolation process.

Stage II of the Extrapolation to 1983. The purpose of the second stage of the extrapolation was to change the sample weights in the presample in a way that would achieve all of the targets in Table 2.2. This amounts to solving 23 linear equations in 75,422 variables. All that is required is a criterion by which to choose one of the many solutions. Our criterion is stated in terms of an objective function that measures the change in the sample weights. Simply stated, the mathematical method selects the new weights in a way that will "hit" the targets and simultaneously minimize the objective function.

Since stage I of the extrapolation adjusted all data items proportionally for inflation (excepting special cases), the correlation among the data items on each return have, for the most part, remained unchanged and simultaneously, the important targets have been achieved. Achieving additional targets in this stage can only be accomplished by introducing distorting adjustments to the sample weights. Thus, our objective function contains an arbitrary measure of the distortion caused by changing the weight on any return. This measure depends on the ratio of the new weight to the old weight: if the ratio is close to 1.0, there is not much distortion but if the ratio is closer to zero or exceedingly large, the distortion is large. As the ratio approaches zero, the distortion approaches infinity. Let x represent the ratio of new to old weight for a particular return, and $\phi(x)$ represent the associated distortion (by our arbitrary measure).

For t10he distortion function ϕ, we chose the following:

$$\phi(x) = x^{4} + x^{-4} - 2 \tag{2.2}$$

This choice was arbitrary and can only be justified by the results and by these desirable features:

$$\phi(1) = 0 \tag{2.3}$$

so there is no distortion when the weight is not changed.

$$\lim_{x \to 0} \phi(x) = \lim_{x \to +\infty} \phi(x) = +\infty \tag{2.4}$$

so weights too far from 1 are not tolerated.

$$\phi(x) = \phi(1/x) \tag{2.5}$$

so that the amount of the percentage change is independent of direction. For example. it is as distorting to multiply a weight by 4 as to divide it by 4. It can be shown that any function having these properties must be of the form:

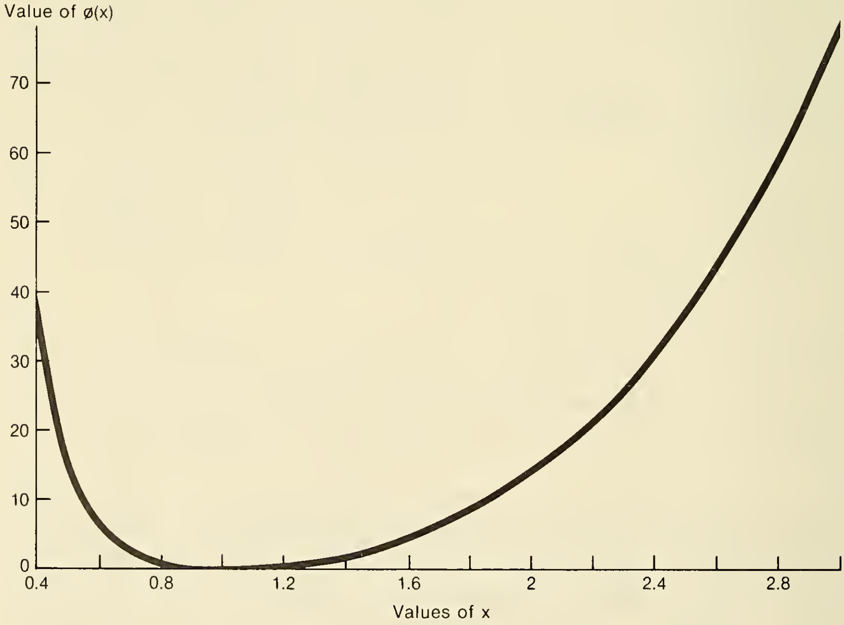
$$\sum^{+\infty} \beta_i \left(x^{i} + x^{-i} - 2 \right) \tag{2.6}$$

It was decided to choose $\beta_4 = 1$ and all other $\beta_i = 0$. The graph of ϕ is shown in Figure 2.2. The complete objective function is obtained by calculating the distortion $\phi(x)$ for each sample return and taking the sum; weighted by the original weights.

Results of the Extrapolation. All of the targets were achieved in Stage II with an average distortion of 0.198 per population return. On average, this was the amount of distortion that resulted from multiplying (or dividing) a sample weight by 1.1166.

Some of the weight changes, however, were extreme (the largest ratio of new to old weight was 8.67 and the smallest was 0.342). Increasing the exponent (that is, the power 4) in our objective function would have forced the extreme values closer to 1, with slightly more distortion among the less extreme returns. Decreasing the exponent would have allowed the extreme values to be more extreme. When the exponent 2 was used in a trial run, the largest factor by which a weight was increased was about 30.

Figure 2.2 **Graph of $\phi(x)$**



e. Partitioning the File

The final step in preparing the SOI file was the creation of two extracts: one for taxpayers 16 years of age and over, and one for taxpayers under 16 years of age. This was done to ensure that comparable files would be merged and is discussed further in Section B.

2. CPS Preparation

Tax return data do not contain information on non-taxable income sources, demographic characteristics of the population, or people not required to file tax returns. To obtain these types of information, OTA used the data collected by the Bureau of the Census in its Current Population Surveys. Every March, the Census Bureau surveys approximately 50,000 households selected to represent the U.S. population, asking them questions about themselves, their family composition, incomes for the previous year, and employment experiences.

A somewhat involved set of adjustments was performed on the CPS data file before it was combined with the tax return data. First, the CPS file was extrapolated from 1982, the most recent year for which data were available, to 1983 levels, the same year as the extrapolated tax return data.

Second, transfer payments (except for welfare payments) were corrected for nonreporting and underreporting in order to produce aggregates consistent with national estimates. For example, public and private pensions, including social security, were adjusted. The correction process grows existing transfer payments and assigns actual transfers to new units based on a vector of socio-economic attributes (a procedure known as "hot decking").

Third, both welfare payments received and the number of recipients were simulated based on the characteristics of the households on the CPS file and the criteria for eligibility for welfare programs in 1983. This simulation effectively replaces all of the original data. However, units that originally received transfer payments, in general, still receive transfer payments.

Next, households in the CPS were converted into potential tax filing units by applying tax filing rules to each person age 16 and over in the family. This placed the CPS file on a comparable basis with the file of taxpayers age 16 and over. This process created two CPS extracts: (a) potential filers and (b) potential non-filers (CPS tax units who do not need to file a return under 1983 law because their incomes are too low). In families with multiple tax units, units other than the family head were deemed to be "dependent filers."

The final set of adjustments, called the premerge alignment, consisted of two steps. The first step, the filer/non-filer alignment, ensured that the CPS file represented the same number of tax returns as on the SOI file. This process created additional CPS filers from the extract of potential CPS non-filers. The second step corrected certain forms of income for underreporting and nonreporting on the CPS. This process ensured that the files of both tax returns and CPS filers had the same amounts of income from major sources. It also ensured that certain forms of income and the number of people reporting income from these sources were consistent with national aggregates. For example, the CPS file consistently showed smaller amounts of interest, dividends, and other forms of capital income than what is reported on the SOI file. Consequently, as part of the premerge alignment the amounts of capital income and the number of units reporting capital income on the CPS file were increased.

B. The Merge Process[4]

At the beginning of the merge process there were four 1983 level files:

- The SOI with taxpayers age 16 and over,
- The SOI with taxpayers under age 16,
- CPS filers, and
- CPS non-filers.

The preparatory work ensured that the SOI files and the CPS files were consistent with each other and were both representative of the U.S. population.

Two of these files, the SOI with taxpayers age 16 and over, and the CPS filers, were merged on the basis of a common set of core variables, principally the dollar amounts of major income sources and key demographic variables. The merge process was a "soft match," or a "statistical match," which applied a state-of-the-art extended transportation algorithm capable of determining which SOI return should be matched with which CPS return. This determination was made by minimizing a "penalty function" that expresses the statistical cost of mismatching, i.e., matching a SOI return and a CPS return with dissimilar common core variables. Some CPS records were matched to multiple SOI records and vice versa because the SOI file had a high proportion of returns from upper-income classes while the CPS file had many tax filers from low-income classes.

Once these two files had been merged, the CPS non-filers were appended. Next, the data base was sorted by CPS family identification numbers to reconstruct families. Finally, taxpayers under age 16 were merged with families judged to have appropriate income and demographic characteristics. This was accomplished by partitioning further the SOI file with taxpayers under age 16 into three sets:

- Returns with income less than $200,000 and with at least some wages and salaries,
- Returns with income less than $200,000 and from capital income only, and
- Returns with income in excess of $200,000.

Returns from partition 1 were randomly merged with families from all income levels while returns from partition 2 were randomly merged with families earning more than $50,000 annually. Finally, returns in partition 3 were randomly merged with families whose income exceeded $200,000. To qualify for selection, the age of a taxpayer in a SOI partition had to exactly equal the age of a dependent in the family. Furthermore, the sample weight for a return in the SOI partition had to be equal or similar to the family weight.

The resulting merge file contained nearly 200,000 records which represent 122 million potential tax units: 97 million tax filers (of which 13 million are dependent filers) and 25 million non-filers. At this point in the process, each record contained approximately 500 data items from the tax return, SSA, and CPS data.

The merge process has both strengths and weaknesses. One of the main advantages of merging two data sets through a statistical match is that the procedure preserves the relationships among the variables in each file, i.e., it maintains the variance-covariance matrices. However, one of the shortcomings is that, beyond the common core set of variables, nothing is really known about how the SOI variables are correlated with CPS variables. The statistical reliability of the match depends, moreover, on the assumption that for each merged observation, the values for the non-core SOI variables were statistically independent of the non-core CPS variables.[5]

C. The Imputation Process

1. Imputations to the Merge File

Once the MERGE file had been completed, additional information was imputed to the data file. Approximately 250 data items were imputed to provide information such as:

- Industry where the taxpayer is employed,
- Employer contributions to entitlement programs, insurance plans, pension plans, and fringe benefits,
- Tax exempt interest,
- Unreported and underreported income for filers and non-filers,
- Earnings on pension and life insurance funds,
- Home ownership variables such as market value, rent, depreciation, and maintenance expense,
- IRAs, KEOGHs, and unemployment compensation,
- Taxpayer's share of corporate profits,
- Types, holding periods, selling prices, and capital gains or losses of capital assets sold during the year.
- Unemployment compensation.
- Military benefits,
- Food stamps, and
- Consumption for 32 different items.

For most variables, the imputation process consisted of five steps.

(1) Selecting the Item to be Imputed. In this step, the exact item to be imputed was conceptually defined, and the aggregate amount to be attributed to the MERGE file was determined.

(2) Selecting a Data Source. A reliable exogenous source of data that contained attributes in common with variables already on the MERGE file was obtained. Sources included special surveys made by other government agencies or private organizations, or tax returns filed in another year. Although another micro-data file was the preferable source, sources were sometimes cross-tabulations or if necessary, simple tabulations.

(3) Determining a Statistical Relationship. An estimate was obtained of the statistical relationship between the imputation item and the attributes in common with variables in the MERGE data and the source data. If the data source was a micro-data file, the relationship was usually a regression equation but sometimes was a table of probabilities and average amounts. If the data source was a cross-tabulation or simple tabulation, the tabulation had to provide the statistical relationship.

(4) Designing the Imputation Methodology. Using the estimated statistical relationship, a methodology was designed to impute the item to the appropriate records on the MERGE file. If the source data were extensive, this step applied sophisticated econometric techniques to reproduce some of the unexplained variation in the original item. Even if the source data were very simple, a two-step procedure was often used: (a) records were randomly selected, in accordance with a probability distribution, to receive the imputed item, and (b) the amount of the item was calculated in accordance with its distribution about some mean amount.

(5) Calibrating the Imputation. To assure that the total for any imputed item (summed across all the records in the file) equaled the correct aggregate for the economy, imputed amounts were usually adjusted or calibrated. These adjustments were necessary because the imputation process was imprecise and the populations represented by the source and MERGE data frequently differed.

2. Additional Imputations for Tax Reform

Several additional imputations were made in the middle and latter stages of tax reform. These imputations were frequently made in response to a particular tax reform proposal. So, the level of detail in the imputations often reflect the rules or definitions contained in the reform proposal. Further, the imputations were often adjusted because of new information, or to reflect changes in the original proposals. Unlike the imputations listed in the previous section, these imputations were not included in the data file. They were created in each simulation where they were required. Some of the more important additional imputations were:

- Interest expense on second homes,
- Meals and entertainment expenses (for wage and business returns),
- Adjustments to percentage depletion preferences,
- Adjustments to intangible drilling costs preferences,
- Health insurance for the self-employed.
- Passive partnership income,
- Passive farm income,
- Passive rental income,
- Active and passive partnership rental incomes,
- Passive business interest expenses,
- Adjustments to income from changes to at-risk rules for real estate activities,
- 401(k) pension contribution levels, and
- Pre-retirement distributions (withdrawals) of pensions.

D. Extrapolation Over Multiple Years

During the tax reform process, policymakers became interested in the revenue effects of certain tax law changes over the five year period immediately following enactment. In particular, policy makers wanted to know the revenue effects of tax reform proposals between 1986 and 1990, and subsequently between 1987 and 1991.

To address these questions, a procedure was developed whereby the data base could be extrapolated from its 1983 levels to any year up to 1995. The procedure, largely developed by the staff of the Joint Committee on Taxation, consists of adjusting the values of variables for each return by a set of growth factors for each year. The weights of each return are adjusted to reflect changes in the demographic profile of the tax filing population. The growth factors for important variables are set by income class, while less important variables have a single growth factor. Further, the growth factors are easily adjusted to reflect new or alternative economic forecasts.[6] The revenue estimates of individual tax provisions in the Tax Reform Act of 1986 (P.L. 99-514) are largely based on model simulations using files extrapolated by this procedure.

III. DESCRIPTION OF THE SIMULATION MODEL

The computer program component of the Treasury's individual income tax simulation model consists of approximately 12,000 ASCII FORTRAN statements and 250 control stream instructions. The FORTRAN program contains 114 subprograms which are grouped to form three parts or phases. Each phase is executed separately after executing the previous phase.

Since January 1981, the Treasury individual income tax simulation model has been implemented on a UNIVAC 1100/82 computer. On this system, the program's execution time varies with the size of the tax sample and with the complexity of the tax proposal under analysis. A simulation on the full Tax Reform Data Base of 200,000 records requires approximately 25-35 minutes of processing time while the smaller SOI sample of 75,000 returns requires approximately 10-12 minutes.

Section A below provides the reader with an overview of the three phases in the individual income tax model. Phase I, the input of parameters is briefly explained in Section B. The tax calculator, Phase II, is discussed in some detail in Section C and the outputs produced by the model, Phase III, follow in Section D. Finally, Section E describes the post-simulation adjustments to the model results.

A. Design Philosophy of the Tax Model

In the tax model, the tax law currently in effect is defined by various tax parameters which collectively are called Plan X. Similarly, the set of tax parameters which define a proposed tax law are referred to as Plan Y. Normally, the number of differences between Plan X and Plan Y are small in relation to the total number of tax parameters in Plan X. The design of the tax model program incorporates this feature by initially assuming that no differences exist between Plan X and Plan Y, i.e., that Plan X = Plan Y. This design simplifies data preparation for the user, who has only to specify how Plan Y differs from Plan X in order to completely define Plan Y.

Another design feature of the tax model program is its capability of comparing two alternative tax proposals with Plan X. Normally, a user will want to compare Plan Y with Plan X and analyze the results. In some cases, however, the user may want to compare one tax proposal, Plan Y, and a second tax proposal, Plan Z, with Plan X in the same simulation to determine which option individual taxpayers would elect.

Finally, it is desirable to have a tax model program that could produce summary results, detailed results, or both, while minimizing execution time. Consequently, all of the statistical tables, except the "standard" tables, are optional and must be specifically requested.

1. Phase I

Phase I of the simulation is basically an initialization and preparation stage. It begins by inputting operational data such as the run description, the characteristics of the data sample that will be inputted, the desired output tables, the editing required on these tables (if any) and which tax plans will change in the simulation. Next, all tax parameters in Plan Z, if requested, are equated to those of Plan X. (Plan X and Plan Y are already equated to each other unless specified otherwise). The remaining data are inputted and used to modify the tax parameters in one or more of the tax plans so that Plan Y does not equal Plan X (and Plan Z if relevant). The remaining execution of Phase I prints the tax parameters under the alternative plans and prepares the stubs for the tables of taxable income by marginal tax rates, if they were requested.

2. Phase II

The primary function of Phase II is to process the data from the sample of individual income tax returns under each tax plan that was specified in Phase I. First, Phase II calculates the amount of storage space needed to produce each of the tables requested by the user and acquires this storage. Second, each data record is inputted and tax liability for the record is calculated under Plan Y and if requested, Plan X. Third, the requested statistical tables are updated. After all returns have been processed, operational statistics are printed, and the statistical tables are outputted to a temporary file.

3. Phase III

Phase III of the tax model is designed to process and output the results of Phase II. Initially, Phase III calculates the maximum amount of additional storage required to produce the requested tables and acquires this storage. Immediately thereafter, the program will input each statistical table (requested in Phase I) from the temporary file (created in Phase II). After the particular table has been inputted, a subprogram designed to perform the final processing and output for that table is executed. The subprogram will output each page of the table that the user requested in the Phase I input.

Finally, Phase III permanently stores summary results of the tax model run and prints the processing and elapsed times required for the execution of the simulation.

B. Description of the Tax Model Input Parameters

Each tax model simulation solicits operational data in eight steps. This data provides information necessary to prepare the run, select what output will be produced and determine how certain tax parameters will be changed. This data when combined with changes to the tax calculators, completely document a tax model run. Briefly, the eight specification steps are:

(1) Describe and identify the run.
(2) Specify the data sample to be used and the number of observations to be processed.
(3) Specify which basic tax regime will be used for Plan X (e.g., 1986 law).
(4) Specify which tables are to be printed and the unit of analysis.

(5) Specify for the tabular output the income concept used for distributional classification, the stubs for the income classifier, the specific pages to be printed, and the desired disaggregation of the tables.
(6) Specify which tax plans will have parameter changes or rate changes.
(7) Specify the changes in tax parameters for each plan.
(8) Specify any changes in the regular and alternative minimum tax rate schedules.

The tax model currently contains tax parameters for six tax regimes; 1981 law through 1984 law, 1986 law, and a fully phased-in law at 1984 levels. (A parameter set for the Tax Reform Act of 1986 is currently being formed.) The desired tax regime is specified in step 3.

An important input parameter specified in step 7 is an inflation indexing value. Consider the case where the tax regime being examined is 1986 law. Since the basic data is at 1983 levels, the dollar values of the tax parameters need to be deflated to 1983 levels (i.e., 1986 law at 1983 levels). The analyst only needs to specify that 1986 parameters will be used and the appropriate indexing factor between 1983 and 1986.

Now then, consider the case where the tax regime being examined is 1988 law. Some, but not all parameters are indexed for inflation by statute beginning in 1984. In this case, those parameters that are indexed need to be inflated to their (expected) 1988 levels, then all parameters need to be deflated to 1983 levels. This procedure has been routinized so that the analyst only needs the indexing factors (CPI) for 1983 through 1988.

C. The Tax Calculator

The heart of the individual tax model are three almost identical tax calculators that are used in Phase II to calculate Plan X, Plan Y, and Plan Z tax liability. The only difference between the calculators is the names of the variables they determine. Thus, AGI in Plan X (AGIX) can easily be distinguished from AGI from Plan Y (AGIY).

The calculator takes information from each potential tax filing unit in the data file, and using a set of tax parameters, calculates that unit's Federal individual income tax liability under the appropriate tax plan. The tax calculator also computes the values of several variables that affect tax liability. Table 2.3 presents a list of variables that are endogenous to the tax calculator. (Several more items will be added to this list when tax reform law becomes a standard part of the model.) Note that the calculator does not endogenously determine levels of capital gains (or losses), unemployment compensation, or social security income. It only determines the portion of these items included in AGI.

Not every variable in Table 2.3 is determined in every simulation. Some variables in Table 2.3 may not be applicable to the tax law requested by the

Table 2.3 **Items Recalculated by the Tax Calculator (Prior to the Tax Reform Act of 1986)**

Capital Gains included in AGI.
Dividend (and interest) exclusion.
All savers interest included in AGI.
Deduction for a married couple when both work.
Unemployment compensation included AGI.
Social Security income included in AGI.
Adjusted gross income (AGI).
Zero bracket amount (ZBA).
Personal exemption.
Medical expense deduction(s).
Casualty and loss deduction.
Total and excess itemized deductions.
Unused ZBA (for returns required by law to itemize).
Earned income (for dependents with unearned income).
Taxable income.
No benefit exclusions for minimum and alternative minimum taxes.
Itemized deductions for minimum tax purposes.
Regular tax liability.
Statutory marginal tax rate.
Personal service income (PSI).
Taxable PSI.
Tax savings from the maximum rate on PSI.
Tax liability after tax savings.
Child care credit.
Energy credits.
Political contributions credit.
Tax liability after credits.
Total itemized deduction for minimum, alternative minimum, maximum, and alternative maximum tax purposes.
Total preference items for minimum and alternative minimum tax purposes.
Taxable income for the minimum and alternative minimum taxes.
Tentative minimum tax on tax preferences.
Minimum tax and alternative minimum tax.
Earned income credit.
Final tax liability.

user. For example, the maximum tax on personal services income is only calculated when pre-1982 law is requested. Similarly, the individual minimum tax is only determined when pre-1983 law is requested.

There are three basic methods for simulating a tax regime other than current law: change tax parameters, change the coding of the tax calculator, or change both. Tax parameters are changed using a set of input parameters (described in the next section). The tax calculator is changed by deleting certain lines of code, inserting new lines of code, or by doing both.

Two implicit behavioral assumptions are used in the simulation model. First, all filers choose tax options that minimize their tax liabilities. Second, there are no behaviorial or "feedback" effects on variables exogenous to the model. These variables include the level and distribution of pre-tax income or expenditures on deductible items. This latter assumption implies that only first round effects are simulated. Although one may believe some feedback effects will occur, assuming no feedback effects is often the logical starting place for analysis.[7]

Limitations. The tax calculator is quite robust, and can trace through most of the interactions between any income source and the various provisions of the Tax Code. However, it does have limitations. These include:

- The calculator does not simulate the effects of changes in tax law on a number of small but important provisions in the tax code. Among these are state and local tax refunds, income averaging, the foreign tax credit, the elderly credit, and the investment tax credit. Values for these variables are assumed to remain constant within the simulations.
- The calculator does not capture behavioral responses of individuals to marginal changes in disposable income or prices. For example, the model would not capture changes in charitable giving due to changes in tax rates or incomes.
- Simulations often require imputed data (data not contained on original tax returns but necessary in computing tax liability under one or more plans). Although every effort is made to correctly impute data items, errors are unavoidable. Within any simulation, variables containing imputed data will interact with other variables in the model. To the extent that imputation errors were made to one or more variables in some systematic way, the results of simulations will be biased.
- Intertemporal interactions are not accurately captured by the tax calculator (at least at the micro level). For example, changes to rules relating to loss or credit carryovers not only affect the current tax regime, but also affect future tax regimes.
- Finally, many of the imputations for non-itemizers are based on values of variables on tax returns such as AGI. For example, the imputation for state and local income tax deductions was based, in part, on AGI. Therefore, these imputations should be adjusted when the "base" variables change. For simplicity, such adjustments are not made.

While these limitations are easy to identify, they are difficult to correct. So, these limitations may be corrected "off model." That is, if the analyst believes the tax model does not accurately portray the effects of a tax law change, he may make adjustments to the final output of the simulation run. Post adjustments to tax model simulation results are discussed in Section E.

D. Outputs Produced by the Model

The output from the simulation model consists of six sections but most of these are of a operational nature and will not be discussed here. One section, however, is of paramount importance to the analyst: the tabulated tax statistics.

The tabulated tax statistics consist of "standard" output tables and optional output tables. The standard output tables are produced by default. These tables present information that, through experience, analysts have found to be most useful. The standard tables are produced on either a tax return or family basis.

Table 2.4 lists the tax model tabulations for analysis on a tax return or, family basis. The Appendix provides a more detailed description of the tables

Table 2.4 **Tax Model Tabulations for Analysis by Output Table Number**

Output Table No.	Contents of the Tabulation
Tax Return Basis	
1	Distribution of Income Tax Liabilities
2	Distribution of Average Tax Liabilities
3	Sources of Income and Adjustments
4	Taxable Income, Deductions, and Credits
5	Distribution of Tax Change and Returns
6A	Cumulative Taxable Income and Tax by Marginal Tax Rate
6B	Taxable Income by Marginal Tax Rate
7	Distribution of AGI, Tax, Effective Tax Rates, and After Tax AGI
8A	Summary Effects of the Proposal by Filing Status
8B	Aggregate Summary Effects of the Proposal
9	Tax Burdens for Hypothetical Tax Returns
10	Distributions by Filing Unit Size
11	Computation of Iles (e.g., deciles).
Family Basis	
12	Distribution of Income Tax Liabilities
13	Distribution of Tax Change and Families
14A	Summary Effects of the Proposal by Family Size
14B	Aggregate Summary Effects of the Proposal

produced for analysis on a tax return and family basis. These descriptions are not intended to be comprehensive but rather to provide an overview of the model's capabilities.

E. Post-Simulation Adjustments to the Model Results,

The tax model does not always capture some known effects of a given tax regime or the effects of a change in the tax code. The tax model may also be incapable of providing the exact information desired by the analyst. There are several reasons why this may occur:

- The data may not be at the level desired by the analyst. Tax data, like any other data, is rarely as current as the analyst would like it to be.
- The data may be incomplete. For example, information on alternative minimum tax preference items is only available from those returns that actually paid minimum or alternative minimum taxes. No imputations were made to people who have these preferences but did not pay these special taxes.
- The appropriate data may not be on the data file. For example, the data file does not contain information on scholarship or fellowship income.
- Inappropriate targets may have been used in the extrapolation procedures. The target values in any extrapolation process are simply estimates of future levels of variables. Unavoidably, the target values will not be the same as the actual values. This problem is exacerbated when the target levels are determined before some change in the economic environment (e.g., a change in tax law). Thus, distributions and aggregate amounts in an extrapolated file will not be exactly the same as those found in an actual file. Further, the extrapolation process is expensive and time consuming, and so a new extrapolation is not made every time new information about the future becomes available.
- The individual model is used to make tax revenue estimates under various economic scenarios (e.g., different interest rates, inflation rates, or rates of economic growth). Again, the costs of creating a new projected file for each variant in economic conditions is prohibitive.
- The tax calculator currently does not capture behavioral responses or the interaction among certain variables.
- In addition to analyzing tax liabilities, the tax model is used to estimate changes in tax receipts. Tax liabilities are generally analyzed on a calendar year basis, while receipts are analyzed on a fiscal year basis. In addition, there is a time lag between the time when tax liabilities are incurred and when the taxes are actually paid. So, calendar year tax liability estimates are converted to fiscal year tax receipts.

To deal with these problems, off-model adjustments are made to the tax model results. For example, the analyst may inflate or deflate values, or he may adjust the output values of certain variables based on some separately acquired elasticity estimates. The adjustments may be simple or sophisticated, depending on the questions being answered. Further, the tax model will often be used in making off-model adjustments.

This emphasizes the fact that the individual tax model is only one tool used by the analyst. It does not and cannot provide the definitive answer to all questions relating to individual income taxes. So the analyst must use other tools to answer questions he faces.

IV. SIMULATING THE EFFECTS OF TAX REFORM

The individual tax model became a veritable workhorse during the tax reform process. Over the last four years, the model was used to estimate the effects of thousands of proposed changes to the tax code in developing Treasury I and II and that arose before and during the House mark-up, the Senate mark-up, and the Conference Committee deliberations. The proposed changes could be very simple (e.g., changing the floor on medical deductions from 5% of adjusted gross income to 7.5%), or they could be very complex (e.g., imposing a 28% top rate on capital gains).

Although the individual income tax model is used to answer many questions, the kinds of analyses that it addresses can be classified into ten general groups. These are enumerated below.

(1) Estimates for a Single Provision or Set of Provisions. To examine the effects of a single provision or set of provisions, Plan X and Y are set so that they only differ by the provision or set of provisions being examined. Note that Plan X does not need to be present law, so that, for example, the model could be used to estimate the effect of a single variant of the House bill.

(2) Stacking Series. When examining a set of multiple provisions, the analyst may want to separate the effects of the package into the component provisions. This is accomplished through a stacking series. In a stacking series, each provision is estimated separately. Three types of stacking series are possible; stacked-first, stacked-last, and stacked-sequentially. Under stacked-first, each provision is compared to the same Plan X (usually current law). Under stacked-last, Plan X contains all of the provisions except the one being examined, while Plan Y contains all provisions. Stacked-sequentially starts out with present law (or some other base tax regime) in Plan X and the same law plus one provision in Plan Y. In the next simulation, the old Plan Y becomes the new Plan X, and a provision is added to the new Plan Y. This continues for all provisions. In some cases, it is possible to stack the provisions recursively so that each added provision does not interact with any of the previously stacked provisions.

(3) Interaction Among Provisions. The tax model is an excellent tool for estimating the interrelationships among individual tax provisions. Because of

interactions among provisions, adding up the effects from each of the stacking series will not give the combined effect of all of the provisions. For example, changing tax rates will affect the values of deductions, and changing the levels of deductions will affect the amount of revenue generated by the rate structure.

(4) Sensitivity Analysis. Often the analyst is interested in how responsive the tax system is to certain tax parameters. Using the model, the analyst can determine the change in tax liabilities due to a change in a tax parameter. The analyst may also be interested in the sensitivity of the tax system to economic variables. For example, the analyst can get a sense of how interest rates affect certain tax variables by adjusting interest income and interest expense items.

(5) Estimating Average Marginal Tax Rates. One of the most useful attributes of the individual tax model is its ability to estimate average marginal tax rates. To obtain marginal tax rates, the Federal income tax liability under a given tax regime is calculated for each return on the data file. Then, the value of an income source is increased by a small amount (usually one percent). The model recalculates each return's tax liability and the change in tax associated with the change in income. The tax and income changes are summed over all returns, and their ratio computed to give the average marginal tax rate for that income source. This, in effect, gives a rate that is weighted by the amount of the particular income source appearing on each return. Alternatively, the marginal tax rate for each return can be multiplied by that return's weight in the population. This leads to an average marginal tax rate that is weighted equally among all returns (or all returns with that particular income source).

Table 2.5 contains estimates of average marginal tax rates under 1980 law, 1986 law, and P.L. 99-514, the Tax Reform Act of 1986 (TRA). Under each tax regime, marginal tax rates are presented for wages, interest income, dividend income, noncorporate business income, and net capital gains. All computations were performed at the 1983 level and distribution of income. To be consistent, all dollar-valued tax parameters were inflated or deflated to 1983

Table 2.5 **Average Marginal Tax Rates on Selected Income Sources under 1980 Law, Current Law, and the Tax Reform Act of 1986**
(1983 income levels)

Income Source	1980 Law	Pre-Tax Reform Law	Tax Reform Act of 1986
Wages	29.1 %	25.8 %	21.7 %
Interest	28.5	25.5	21.5
Dividends	39.0	32.9	25.7
Non-Corporate Business	29.6	25.0	21.0
Net Capital Gains	16.6	13.8	21.5

levels using the consumer price index (CPI). So, to calculate 1980 law, all tax parameters were inflated from 1980 levels to 1983 levels. Similarly, the calculations for 1986 law deflated all parameters to 1983 levels. For most parameters under TRA, the dollar-valued parameters were deflated from 1988 levels to 1983 levels using the 1983 CPI and the (estimated) 1988 CPI. Exceptions occurred when transition rules extend beyond 1988 (e.g., transition rules apply to the personal exemption until 1989). In these cases, the parameters were deflated from their fully phased-in levels to 1983 levels.

The average marginal rates under each of the three laws in Table 2.5 are fully phased-in. That is, the rates are calculated without regard to any transition rules. For example, under fully phased-in 1986 law, there is no above-the-line deduction for charitable giving since it expires after 1986. Similarly, the TRA provisions assume all of the transition rules have already occurred. (Under the fully phased-in assumption, it was implicitly assumed that all dollar parameters are indexed for inflation beginning in 1986.)

(6) Incorporation of Behavioral Responses. As mentioned earlier, the tax calculator does not account for any behavioral responses to changes in the tax code other than tax-minimizing choices like the decision to itemize. Estimates of behavioral responses are generally made "off model." On occasion however, the analyst may explicitly define a behavioral response to a particular change in the tax code. For example, In one project the price and income elasticities of charitable giving were incorporated into the model to estimate how particular changes in the tax code affect levels of charitable contributions.

(7) Distributional Analysis. The model is also extensively used for distributional analysis. For example, policymakers are interested in how individual income tax liabilities, and changes in these liabilities are distributed among the population. As part of the standard output of the model, the distribution of tax liabilities of tax units or families is presented in every model simulation.[8] However, because the model uses microdata, the effects of tax reform can be seen on almost any subgroup of the population.

Because of the tax model's rich data base, individual income tax liabilities can be distributed by almost any income classifier desired. The most common classifier used during tax reform was AGI. However, AGI is often an inappropriate income classifier because it is tied to a particular tax law, and because it does not accurately measure "economic well-being." So, an "economic income" measure was constructed that approximates the Haig-Simons definition of income (consumption plus change in net worth).[9]

(8) Gainers vs Losers. A common question that arises with any tax reform proposal is, who gains and who loses. A gainer is usually defined as a tax return or family that pays less tax, while a loser pays more tax. A special class of gainers are those returns or families who are removed from the tax rolls (tax liability changes from positive to non-positive) under the proposal. Conversely, a special class of losers are tax returns or families who were previously non-taxable, but must pay some tax under the proposal.

As part of the standard output of the model, the number of gainers and losers and the amount of their gain or loss are tabulated. The output includes the special gainers and losers who are either removed or added to the tax rolls. Additionally, the model can break down the gainers and losers by filing status (or family type), and whether the return itemizes or not. A portion of standard output of the individual tax model is shown in Table 2.6 The table shows at 1983 levels the number of families with tax increases or tax decreases from the individual provisions of the Tax Reform Act of 1986.

(9) Analysis of Non-Income Taxes. Because of its rich data base, the tax model has also been used for analysis of non-income taxes. For example, the tax model has been used to determine the distribution of Federal excise taxes on gasoline, as well as the level and distribution of social security taxes. Also, as part of Treasury I, the model was heavily used in simulating a value added tax.[10]

(10) Special Cross Tabulations. Because the tax model relies on microdata, cross tabulations can be made on any set of variables before and after a tax change. Frequently, the analyst may want to know how a particular subgroup of the population fares under a tax proposal. The analyst may also want to know the characteristics of gainers or loser (e.g., what variables cause a person to be a gainer or loser). The analyst often wants information on the levels of certain variables before and after the proposal (e.g., the level of medical expenses deducted or IRAs purchased). The tax model is a highly flexible tool for addressing such questions.

V. FUTURE MODEL DEVELOPMENTS

As the focus of tax policy shifts, the individual income tax simulation model requires new capabilities that often cannot be anticipated. Furthermore, data is constantly replaced with more current, more accurate, and more comprehensive data. Since the development of a modeling system is dynamic, there is always room for improvement and the individual tax model is no exception.

This section outlines improvements to the individual tax model that Treasury hopes to pursue and achieve in the near future. These improvements can be grouped into two categories: data improvements and simulation model improvements.

A. Data Improvements

Extrapolation. Of particular importance to OTA is the ability to accurately and efficiently extrapolate the tax model's data base to future levels. This involves simultaneously adjusting data values and/or weights to expected levels and distributions of target variables. while maintaining the "integrity" of each data record. To accomplish this. an efficient convergence algorithm is required. Further work is also needed in accurately predicting the levels and distributions of the target variables.

Table 2.6 **Distribution of Tax Change and Number of Families Affected by Economic Income for Families**
(1983 Levels of Income)

	Presently Taxable Families Made Nontaxable		Presently Nontaxable Families Made Taxable		Families with a Change in Tax Liability					
					Tax Decreases			Tax Increases		
Economic Income (Dollars)	Number of Families (Units)	Amount of Tax Decrease ($ Mil)	Number of Families (Units)	Amount of Tax Increase ($ Mil)	Number of Families (Units)	Amount of Tax Decrease ($ Mil)	Plan X Tax Liability ($ Mil)	Number of Families (Units)	Amount of Tax Increase ($ Mil)	Plan X Tax Liability ($ Mil)
Under 0	7459.	-.641	15671.	321.687	54008.	-13.205	29.237	29020.	522.181	115.953
0 – 10000	731277.	-121.852	88411.	48.034	3957447.	-493.511	929.921	528548.	183.883	293.569
1000 – 15000	1597172.	-1002.689	84778.	38.086	7499738.	-1947.672	4061.943	1076631.	277.802	741.804
15000 – 20000	1343858.	-822.211	80509.	55.685	7912581.	-2374.442	7780.005	1404243.	488.746	1361.253
20000 – 30000	871054.	-487.649	166339.	140.556	13172149.	-4365.714	24260.029	3416366.	1282.606	4858.896
30000 – 50000	219448.	-107.142	132777.	174.299	15639579.	-8009.392	56326.663	4938437.	2871.225	13083.117
50000 – 100000	26886.	-11.833	50309.	190.032	8407182.	-7067.475	61556.928	3686113.	4400.159	21516.679
100000 – 200000	20.	-.002	5253.	79.029	1066485.	-3215.352	22828.720	479248.	2656.358	7325.575
200000 and Over	90.	-1.654	3777.	390.354	277420.	-7535.238	27255.161	119302.	4794.185	10844.304
All Family Types	4797264.	-2555.672	627825.	1437.761	57986589.	-35022.001	205028.604	15677909.	17477.145	60141.147

Note: Behavioral changes not included. Numbers reflect many but not all the provisions of the individual income tax code.

Imputations. Several improvements to the imputation process are expected to occur when the next tax reform data base is created. For imputations to non-itemizers, OTA is exploring the possibility of using a maximum likelihood technique for estimating values of missing variables. In order to have a more internally consistent set of imputations, OTA is also examining the possibility of using a simultaneous imputation technique.

The results from several recent studies sponsored by the Treasury Department will be used for many new tax model imputations. For example, OTA is currently developing a data set which contains a sample of tax returns from the same taxpayers over a five year period. This data will be useful in estimating behavioral responses to changes in tax laws. OTA will probably incorporate data from IRS's Taxpayer Compliance Measurement Program (TCMP). This will aid in the analysis and estimation of tax compliance and evasion issues. Finally, OTA will soon obtain information from a W-2 study, which will provide information on wage and pension withholdings and the industries of taxpayers.

The Match Process. OTA will continue to develop and use state-of-the-art techniques when statistical matching data sets. Recent literature suggests that the conditional independence assumption (required in statistical matching) may be relaxed when additional information on the joint distributions of non-matching variables is available.[11]

OTA is considering the possibility of matching SOI data with something other than CPS data. In particular, a match with the Survey of Income and Participation is being considered. in order to place consumption on the data file, OTA is also considering a match between SOI data and data from the Bureau of Labor Statistics' Consumer Expenditure Survey.

B. Simulation Model Improvements

Behavioral Effects. One limitation of the tax model which OTA is attempting to correct is incorporating behavioral responses to changes in the tax code or the economic environment directly into the model, rather than relying on off-model adjustments. For a simple example, it may be possible to determine a relationship between charitable giving and marginal tax rates. Thus, values for charitable deductions would be adjusted whenever tax rates change.

Integration with OTA's Other Models. OTA currently maintains several tax models including a corporate tax model and a depreciation model. It would be useful if results from these models could be directly incorporated into the individual tax model. For example, changes in rules relating to depreciation are accurately captured in the depreciation model. So, a method is needed where changes in depreciation deductions, as calculated by the depreciation model, are translated into changes in taxable business income on the individual model. Similar cases can be made for integration with the corporate, partnership, and general equilibrium models.

Multi-year Model. The effects of almost any change in the tax code will span several years. Also, the impact of a particular provision in the tax code will not be the same in all years. Therefore, it is desirable to have a multi-year tax model. Such a model would simulate the effects of changes in the tax code or economic environment over several years.

Model Efficiency. All users would like the model to run faster. So, OTA frequently examines ways to make the model more efficient. Beginning this year, the tax model will be run on a VAX-8800 computer instead of a UNIVAC 1100/82. This change will make the model faster, more versatile, and have less downtime.

Receipts Estimates. In addition to estimating tax liabilities, it is also important to know when the tax liabilities will be received. This information is very important in formulating the Federal budget, and in estimating how much money the Federal government will need to borrow to meet its financial obligations. With some modification, the individual model might be a useful tool for estimating such things as withholding allowances and tax payment patterns.

Other. Several other improvements to the individual tax model can be pointed to. The model could be modified to simulate the effects of changes in social security tax laws. In the long run, OTA may divide the individual tax model into two sub-models. The first submodel would be used for revenue estimating purposes and would simulate the tax code for a specific year. The second submodel would be used for analytical or distributional analyses, and would simulate hypothetical, fully phased-in tax regimes.

APPENDIX
OUTPUT TABLES FROM THE INDIVIDUAL TAX MODEL

I. Tables for Analysis by Tax Returns

Table 1 presents the distribution of income tax liabilities and the percentage distribution of income tax liabilities for Plan X, Plan Y and the change between Plan X and Plan Y. This table also presents the percentage change in income tax liabilities, i.e., (Plan X tax - Plan Y tax) divided by Plan X tax. The results in Table 1 are distributed by size of present law AGI and are disaggregated by itemizers and non-itemizers.

Table 2 presents the distribution of returns and their average income tax liability for Plan X, Plan Y and the change between Plan X and Plan Y. This table also presents the percentage change in average income tax liabilities, i.e., (average Plan X tax - average Plan Y tax) divided by average Plan X tax. The results in Table 2 are distributed by size of present law AGI and are disaggregated by itemizers and non-itemizers.

Table 3 shows sources of income and the adjustments to gross income for each filing status (single, joint, head-of-household, and all returns) and for each deduction type (itemized, non-itemized, and both) distributed by size of present law AGI. It is a summary of Tables 1.4 and 1.5 in the "Statistics of Income" publication. Table 3 is the only table produced by the tax model that is unaffected by changes in any of the tax plans. Its primary use is to provide the user with a detailed breakdown of the income sources derived from the Treasury's sub-sample for comparison with the "Statistics of Income" publication in the base year and for forecasting income levels in future years.

Table 4 is a tabulation of taxable income, tax credits, deductions, and exemptions for each filing status (single, joint, head-of-household, and all returns) and for each deduction type (itemized, non-itemized, and both) distributed by size of present law AGI. It is a summary of various tables from section 2 of the "Statistics of Income" publication. Table 4 can be used in the same manner as Table 3, that is, for performing comparisons with the "Statistics of Income" publication when forecasting the future levels of credits, deductions, and exemptions. In addition, Table 4 may be used to estimate the effects of changes in the levels of credits, deductions, or exemptions by comparing the new levels with the levels computed for present law.

Table 5 presents a summary of the number of returns affected by the tax proposal and their associated tax change for each filing status (single, joint, head-of-household, and all returns) and for each deduction type (itemized, non-itemized, and both), distributed by size of present law AGI. Each return that has a tax change will be tabulated in either the "tax decrease" or the "tax increase" columns. In addition, a return with a tax decrease may also be tabulated in the "presently taxable returns made non-taxable" column and a return with a tax increase may also be tabulated in the "presently non-taxable returns made taxable" columns. Returns with either a tax increase or tax decrease may also be tabulated in the "returns which changed their type of deduction" columns.

Table 6A presents Plan Y taxable income and Plan Y tax before credits distributed by the marginal tax rate for the specified tax rate schedule (single, joint, head-of-household, and all combined) and for a specified Plan Y AGI size class. In addition, Table 6A provides the cumulative and percentage distribution of Plan Y taxable income and Plan Y tax before credits summed from the lowest to the highest and summed from the highest to the lowest. Table 6A is primarily used to compute new tax rate schedules yielding a predetermined revenue gain or loss.

Table 6B presents Plan Y taxable income by size of Plan Y AGI and by all Plan Y AGI classes for each marginal tax rate in the specified tax rate schedule (single, joint, head-of-household, and all combined).

Table 7 presents the distribution of AGI, tax liability, the effective tax rates (computed as a percentage of a user specified income concept), and the after-tax AGI for Plan X and Plan Y by filing status (single, joint, head-of-household, and all returns) and by size of present law AGI. This table also provides the percentage change in the effective tax rates and in the after tax AGI. These results are disaggregated by itemizers and non-itemizers.

Table 8A provides a summary of the effects of the proposed change (i.e., Plan Y) in the tax law and consists of four pages, one for each filing status (single, joint, and head-of-household) and a summary page for all returns. Table 8A together with Table 8B and Table 5 provides a comprehensive aggregate picture of the revenue and distributional effects of the proposed tax law changes. The results in Table 8A are distributed by size of present law AGI and are disaggregated by itemizers and non-itemizers.

Table 8B presents a summary of most of the items that have already appeared in Tables 8A and 5 as well as some items that do not appear anywhere else in the tax model output. Some of the additional items that appear in Table 8B are:

- The number of taxable returns under Plan X and Plan Y,
- The amount of AGI under Plan Y and the change in AGI,
- The amount of taxable income under Plan X,
- The number of itemized returns under Plan X and Plan Y,
- The number of returns with outlays under Plan X and Plan Y,
- The amount of earned income credit, minimum tax, and alternative minimum tax under Plan X and Plan Y, and
- The amount and change in outlays under Plan X and Plan Y.

The results in Table 8B are distributed by size of present law AGI.

Table 9 allows the user to examine the impact of a tax proposal under specific assumptions with respect to marital status, number of dependents, itemized deductions, and the level of adjusted gross income. In other words, Table 9 presents the tax burdens of hypothetical individual income tax returns for the income and deduction characteristics specified by the user.

Table 10 is designed to provide the distribution of returns and tax liabilities under Plan X and Plan Y by an alternative income concept by size of the filing unit and all filing units, i.e., it approximates a family unit analysis. In addition, Table 10 also provides the percentage distribution of returns and tax liability for each of the tax plans.

Table 11 allows the user to determine in one tax model simulation the level of a ranked variable, usually some income concept, that corresponds to 1/N-th of the total amount of a second variable, usually the population. If N=10 and the ranked variable is adjusted gross income and the second variable is the number of returns, then Table 11 presents the level of AGI that corresponds to each tenth of the population of returns, i.e., deciles. Table 11 will accommodate values of N between 2 and 20.

Finally, the model has the capability to perform special tabulations not covered by the standard or optional tax model tables. These tables are specifically designed for a particular model simulation and are relatively easy to construct. In general, special tabulations may contain an unlimited number of rows and up to 100 columns.

II. Tables for Analysis by Family

Table 12 presents the distribution of income tax liabilities and the percentage distribution of income tax liabilities for Plan X, Plan Y, and the change between Plan X and Plan Y. This table also presents the percentage change in income tax liabilities, i.e., (Plan X tax - Plan Y tax) divided by Plan X tax. The results in Table 12 are distributed by the size of family economic income and are disaggregated by type of family (single individuals, husband and wife, other, and all types).

Table 13 presents a summary of the number of families affected and their associated tax change for each family type (single individuals, husband and wife, other, and all types) distributed by size of family economic income. Each family that has a tax change will be tabulated in either the "tax decrease" or "tax increase" columns. In addition, a family with a tax decrease may also be tabulated in the "presently taxable families made non-taxable" column and a family with a tax increase may also be tabulated in the "presently non-taxable families made taxable" column.

Unlike Table 5, Table 13 contains a column which presents current law tax liability for families with a tax increase or a tax decrease.

Table 14A provides a summary of the effects of the proposed changes (i.e., Plan Y) in the tax law. The results are distributed by size of family economic income and are disaggregated by family type. Table 14A together with Tables 14B, 13, and 12 provide a comprehensive aggregate picture of the revenue and distributional effects of the proposed tax law changes.

Table 14B presents a summary of most of the items that have already appeared in tables 12, 13, and 14A as well as some items that do not appear anywhere else in the tax model output. Consequently, this table duplicates Table 8B but is tabulated on the basis of families. The results in Table 14B are also distributed by size of family economic income.

FOOTNOTES

[1] Roy Wyscarver, *The Treasury Individual Income Tax Simulation Model*. Office of Tax Analysis, 1985.

[2] Internal Revenue Service, *Statistics of Income - 1981 Individual Income Tax Returns*. Government Printing Office, 1983.

[3] For a detailed discussion of the sample reduction methodology, see John Mulvey, "Multivariate Stratified Sampling by Optimization." *Management Science*, vol. 29, no. 6, 1983.

[4] J. S. Turner, and Richard Barr, "A New Linear Programming Approach to Microdata File Merging." *1978 Compendium of Tax Research*, Washington, D.C.: Government Printing Office, 1978.

[5] This problem is documented in, Joseph Kadane, "Some Statistical Problems to Merging Data Files." *1978 Compendium of Tax Research*, Washington, D.C.: Government Printing Office, 1978.

[6] The Joint Committee on Taxation uses Congressional Budget Office forecasts while OTA uses Office of Management and Budget forecasts.

[7] For a discussion of this and other revenue estimating issues, see Howard Nester, "Guide to Interpreting the Dynamic Elements of Revenue Estimates." Chapter 1 in this volume.

[8] A discussion of the distribution of individual income tax liabilities can be found in Susan Nelson, "Family Economic Income and Other Income Concepts Used in Analyzing Tax Reform." Chapter 3 in this volume.

[9] For a discussion of the Haig-Simons economic income concept, see R. Goode, "The Economic Definition of Income." In J. Pechman ed., *Comprehensive Income Taxation*. Brookings Institution, 1977. For a more detailed discussion of the economic income concept used by the Office of Tax Analysis, see Susan Nelson, "Family Economic Income and Other Concepts Used in Analyzing Tax Reform Proposals." Chapter 3 in this volume.

[10] U.S. Department of the Treasury, *Tax Reform for Fairness, Simplicity, and Economic Growth: The Treasury Department Report to the President, Volume 3: Value-Added Tax*, Washington, D.C.: Government Printing Office, 1984.

[11] Gerhard Paass, "Statistical Record Linkage Methodology: State of the Art and Future Prospects," a paper presented at the 45th meeting of the International Statistical Institute, Amsterdam, 1985.

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3 FAMILY ECONOMIC INCOME AND OTHER INCOME CONCEPTS USED IN ANALYZING TAX REFORM

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I. INTRODUCTION

In analyzing the distributional consequences of the Tax Reform Act of 1986 (TRA86), the choice of the income measure by which taxpayers are classified into income groups is an important one. The effects of a particular set of tax changes can look very different under different definitions of income. Similarly, the choice of the population to be examined–taxpayers under current law or all potential taxpayers–and the way people are grouped–by tax units as defined by current law filing rules or by natural family units–also influence the apparent impact of tax reform.

In order to analyze tax changes in a meaningful way, the income classifier should be as consistent as possible with the principles of equity that will be applied to the tax system. The members of each income class should be viewed as being about equally well off, and those in higher-income classes should be considered consistently better off than those in lower income groups.

Since the release of Tax Reform for Fairness, Simplicity, and Economic Growth in November 1984, the Treasury Department has used a measure termed "family economic income" (FEI) in its distributional analyses of tax proposals. This paper explains what is meant by family economic income and how that measure attempts to implement the theoretical concept of income commonly endorsed by economists for use in tax analysis. The paper also discusses some of the limitations of using FEI for public policy analyses. The paper compares family economic income with other measures used in tax analysis for classifying taxpayers according to their relative well-being, specifically adjusted gross income (AGI) and the version of expanded income currently used by the Joint Committee on Taxation (JCT), which is referred to here as

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"modified expanded income" or MEI. Finally, the apparent distributional effects of TRA86 with each of the three income measures as the classifier are presented and examined.

In brief, FEI differs from AGI and MEI in several ways:

- Family. FEI uses the family unit rather than the tax return for analyzing the distributional effects of taxation. Families with nearly equal incomes are more likely to be viewed as being in "equal" circumstances, a requirement for equity analyses, than are tax units with equal incomes. Dependents who file their own tax returns are, for analytical purposes only, combined with those who support them, and the family is put in the appropriate income class.
- Nonfilers. Families and individuals who do not file tax returns under present law are included in analyses based on FEI and MEI, whereas they are usually excluded from analyses using AGI.
- Income. FEI is a comprehensive measure of income, independent of the prevailing tax law. To the extent feasible, it approximates economists' notion of income as consumption plus change in real net worth. It includes many forms of income not reported on tax returns, it measures more accurately other forms of income that are subject to tax, it attempts to avoid double-counting of income, and it adjusts for inflation.

In examining the distributional consequences of the Tax Reform Act of 1986—an act which substantially broadened the tax base and restructured the tax system—family economic income provides a useful standard because of its independence from a particular tax law, as well as its solid conceptual foundation in a comprehensive definition of income.

II. BACKGROUND

Quantifying family economic income in a microdata file suitable for analyzing alternative tax proposals as the Treasury Department has done may be a recent occurrence, but the concept of economic income has been a fundamental part of economic thought for decades. Under the Haig-Simons definition of income (named after its use by Haig (1921) and Simons (1938)), income is the amount that a family or individual consumes in a particular time period plus the net increase or decrease in the value of their assets. This definition is cited repeatedly in academic discussions of income.[1] It reflects economic well-being, or command over resources, because it is the amount that could be consumed without reducing net worth.

In spite of the wide acceptance within the economics profession of the concept, empirical tax analyses have seldom attempted to measure economic income because of a lack of data. Many of the components of economic income are reported neither on tax returns nor on other national surveys. The Treasury Department's first large-scale attempt at overcoming the data problems and approximating economic income came in 1976 in preparation for Blueprints for Basic Tax Reform. That report moved towards a comprehensive measure of economic income, although a narrower concept termed "comprehensive income" was often used to classify tax units for distributional analyses. In congressional testimony in 1982[2], the Treasury Department analyzed the effect of "flat tax" proposals on the distribution of the tax burden by "uniform income" class, an income definition similar to economic income.

As part of the Treasury Department's 1984 study of tax reform that led to Tax Reform for Fairness, Simplicity, and Economic Growth, substantial improvements were made in the data base used for analysing tax reform proposals.[3] The new data base permitted a closer approximation of the theoretical notion of economic income and enabled tax units to be grouped into families.

III. WHAT IS FAMILY ECONOMIC INCOME?

"Family economic income," as developed by the Office of Tax Analysis (OTA), is an income measure that applies to all members of the U.S. population according to the family in which they live, regardless of whether or not they file a tax return under current law.

A. Families

For many people, the tax unit and the family are the same. A family can, however, consist of several tax filing units if dependents have incomes of their own. If children who are dependents for tax purposes have jobs or have investment funds in their own names, they may have to file returns to pay taxes or to receive refunds of taxes that were withheld. Yet, the standard of living of these "dependent filers" derives less from their own income than from the income of their families. Similarly, the family may support other family members who do not qualify for the dependent's tax exemption. In these instances, the family is more meaningful than the tax-filing unit for classifying people in similar circumstances and for assessing the distributional burden of the tax system.[4]

For example, in a family with income of $50,000 a year a teenager may have a part-time job and show the same income on his or her tax return as a welfare mother working occasionally for the minimum wage. The child and the economic unit headed by the mother are not, in a meaningful sense, in similar economic circumstances, however.

In order to analyze the distributional consequences of tax proposals that include any form of consumption tax–such as excise taxes or a value-added tax (VAT)–using the family is particularly important. While most income and income taxes can be attributed to separate family members, it is unclear how to allocate the family's consumption spending, and the accompanying consumption taxes, among individuals. Much family spending is jointly consumed–such as housing–and even individual consumption–such as food and clothing–is unlikely to be related to the income of the dependent family member.

Therefore, for analyzing income and consumption tax proposals, family economic income combines the incomes and the taxes of dependents with the incomes and taxes of those (usually parents) who support them. In 1983, there were 96 million tax returns filed, but the returns came from only 78 million different families.

B. Nonfilers

Since current law does not require all families and adult individuals to file tax returns, using the tax return unit as the basis for analyzing the distributional effects of tax reform omits the effect on current-law nonfilers. Some nonfilers have too little income, or only nontaxable forms of income. Of 92 million families (including unrelated individuals who live alone or in groups) in 1983, over 13 million were nonfilers. Almost half of the elderly and most families below the poverty line are nonfilers.

In many cases the differences between filers and nonfilers are rather arbitrary. Many nonfilers have incomes from nontaxable sources–such as social security, welfare, and tax-exempt interest–as high as tax filers who receive income only from taxable sources. Other filers may have the same amount of income from the same source as nonfilers, but file simply to receive refunds of withheld taxes or of the Earned Income Tax Credit. Since assessments of tax equity should depend on how alternative tax systems treat individuals and families with similar amounts of income regardless of the sources, it is important to include both filers and nonfilers in any distributional analyses. Moreover, proposals to broaden the tax base might impose taxes on some who are nonfilers under current law and exempt some who presently file from paying tax. Tax analyses based solely on tax returns could not provide any information on nonfilers.

C. Definition of Family Economic Income

In attempting to quantify the Haig-Simons concept of income as consumption plus change in net worth, family economic income, as developed by OTA for the 1984 Treasury report, adds together all the forms of income reported on individual tax returns (making adjustments where necessary for correct economic measurement) plus estimates of forms of income not reported on tax returns. Where possible, income is measured on an accrual basis; where that is not possible, realizations are used as a proxy. Family economic income attempts to allocate to individuals all the pre-tax income in the economy from resources owned by individuals.

Family economic income can perhaps be most easily understood through comparisons with two commonly-used measures of income: "personal income" and "adjusted gross income."

1. Comparison with Personal Income

In the aggregate, the measure to which economic income is most similar is personal income (PI) as defined and measured in the National Income and Product Accounts (NIPA). Like personal income, "economic income" attempts to account for all the income of persons in the economy.

There are a few notable differences between personal income and family economic income, however, as Table 3.1 indicates. The largest difference is that FEI includes real retained pretax corporate earnings, which amounted to $155 billion in 1983. This reflects the view that corporations are not separate from their stockholders, but that the income of a corporation is

Table 3.1 **COMPARISON OF PERSONAL INCOME AND FAMILY ECONOMIC INCOME, 1983**

	(Billions)
Personal Income	$2,744.2
Plus: Items in Family Economic Income Not in Personal Income	259.8
Personal contributions for social insurance	119.6
Real pretax corporate retained earnings	154.6
Inflation adjustments on:	
Interest expenses, including mortgage	51.9
Interest received	-88.0
Real net gain from sale of noncorporate assets	21.7
Minus: Items in Personal Income Not in Family Economic Income	101.5
Federal hospital and supplementary medical insurance	57.2
Miscellaneous government transfers	19.3
Investment income received by nonprofit institutions or retained by fiduciaries	25.0
Minus: Miscellaneous differences in measurement and definition–net	20.4
Equals: "Family Economic Income"	$2.882.1

Source: Office of Tax Analysis, and Survey of Current Business, July 1984, April 1985, and July 1985.

income to the individuals who own it, either directly or indirectly through pensions and life insurance funds. On the other hand, the $25 billion of income of nonprofit institutions and fiduciaries, which is part of PI, is excluded from FEI. Although income of nonprofits does become income to someone–the student paying below-cost tuition, the poor receiving charity–there is no obvious way to allocate it to individuals.

The next largest difference is that family economic income includes the $120 billion of "personal contributions for social insurance," whereas personal income does not. FEI is the family's pre-tax economic income. Inclusion is consistent with the view that the link between present contributions and future benefits is weak and uncertain, that the contributions are in effect taxes and that the social security benefits are transfer payments. Excluding the contributions from income suggests that the contributions and the benefits are viewed more like pension contributions and pension benefits.

Some of the other differences between PI and FEI also relate to the characterization of transfer payments. Family economic income includes cash transfer payments but excludes in-kind payments (except for food stamps which function so much like cash), primarily because of the problems of valuation. Family economic income, therefore, excludes the $57 billion of "federal hospital and supplementary medical insurance," and the $19 billion of "miscellaneous government transfer payments" that are included in personal income.

Other differences reflect the fact that personal income, like all NIPA concepts, ignores changes in asset and liability values. In the aggregate, the gains should offset the losses with no income generated for the economy as a whole. Ultimately, product produced must equal income generated. One of the fundamental objectives of family economic income, however, is to capture changes in the purchasing power of assets and liabilities. Family economic income, therefore, includes real capital gains and losses, adjusting the nominal values for inflation, while personal income includes neither capital gains nor inflation adjustments. Although most real gains net to zero in the aggregate since gains are generally matched by losses, for distributional analysis knowing who the winners and losers are is important.

2. Comparison with Adjusted Gross Income

Family economic income differs from AGI in concept and in magnitude. AGI is an artifact of the Tax Code in that it represents only income that lawmakers have decided in a particular year should potentially be subject to tax. Family economic income, on the other hand, is independent of changes in tax law and is useful for analyses of tax policy as well as of other subjects.

Although it is the starting point for deriving family economic income, AGI of tax filers accounts for only about two-thirds of FEI. (See Table 3.2)[5]

° FEI first adds to AGI estimates of the income in the economy that is not reported on tax returns. This consists of income of the nonfilers who do not need to submit returns because their income is so low

Table 3.2 DERIVATION OF FAMILY ECONOMIC INCOME FROM AGI, 1983

	(Millions)
AGI of filers at 1983 incomes defined by pre-TRA 1986 law	$1,939,430
+ Unreported/underreported income of filers	122,414
+ Unreported income of:	
Legitimate nonfilers	25,492
Delinquent nonfilers	103,952
+ Adjustments: IRA & Keogh contributions, dividend exclusion, second-earner deduction, other	59,452
+ Transfers:	
Nontaxable social security and railroad retirement	162,377
Nontaxable unemployment compensation	15,909
Nontaxable workmen's compensation	11,868
Veterans' benefits	12,731
Food stamps	12,266
Welfare benefits (SSI, AFDC, etc.)	22,333
+ Untaxed employer contributions to:	
Pensions and profit sharing	97,120
Health and medical insurance	76,960
Life insurance	6,937
Military benefits and "fringe benefits"	21,908
Other	2,427
− Taxable pensions	-77,496
+ Earnings on pension funds	89,430
+ Earnings on life insurance, IRA, and Keogh funds	22,823
+ Tax-exempt interest	11,005
+ Real net rent on owner-occupied homes	55,357
+ Real pre-tax corporate economic income	223,617
− Dividends before exclusion	-49,587
− Dividend earnings of pension and life insurance funds	-19,410
− Capital gains in AGI	-44,594
+ Real net capital gains (except on corporate stock and other securities)	21,665
+ Inflation adjustment for net interest of:	
Rentals, SBC's, partnerships, and Schedule A	9,995
Schedules C & F	5,977
+ Inflation adjustment for interest received	-88,012
+ Excess depreciation (tax depreciation minus economic depreciation) of:	
Rentals and SBC's	3,171
Partnerships (gainers and losers)	3,049
Schedules C & F	5,162
+ Adjustment for percentage depletion and IDC's	2,297
+ Netting of other losses and miscellaneous adjustments	14,060
Equals: Family Economic Income, 1983	$2,882,085

Note: Some figures differ from those in Chapter 4 of this volume. Here the derivation of Family Economic Income starts with AGI under 1986 law, whereas in Chapter 4 it starts with AGI under 1983 law.

(legitimate nonfilers), as well as income that should be reported, but is not, by filers and by delinquent nonfilers.

- FEI also adds back to AGI certain "adjustments to income" reported on the tax return, principally IRA and Keogh contributions and the second-earner deduction.
- Since FEI aims to measure income in the current year, it adds back net operating losses carried over from previous years.
- FEI includes cash and certain near-cash transfers that are not subject to tax, principally social security benefits, welfare payments, unemployment and workers' compensation, veterans' compensation, and food stamps. Conceptually, "economic income" could include the cash value of in-kind transfers such as housing subsidies, and medicare and medicaid. These were omitted because of the difficulty of valuing them. Studies of the value of such in-kind transfers have found a substantial difference between the cost of the subsidies and the value the recipients attach to the transfer.[6]
- FEI adds in the untaxed portion of compensation such as employer contributions for pensions, health and life insurance, and other fringe benefits. So that pension income will not be double-counted, it excludes pension income as received but includes the accrual of earnings on pension and life insurance plans, and on IRA and Keogh accounts.
- A homeowner's investment in a house implicitly yields net rental income equal to the excess of the gross rental value of the house over costs, with costs including mortgage interest, depreciation, property taxes, and maintenance. This net rental income, adjusted for inflation, is included in FEI. (Personal income also includes net rent, but with no inflation adjustment.)
- As mentioned earlier, FEI allocates pre-tax corporate profits both to individuals who own stock directly and to those who own stock indirectly, for example, through shares of pension or life insurance funds. Implicit in this attribution of pre-tax profits to shareholders is an assumption that the corporate income tax–part of pre-tax profits–is borne by shareholders, rather than, for example, by owners of capital in general, consumers, or labor. This assumption reflects the short-run more than the long-run incidence. (An adjustment in the incidence of a tax could theoretically require adjustment of the pre-tax earnings.) To avoid double counting the portion of earnings that is distributed as dividends, FEI subtracts dividends received, both directly and indirectly. Similarly, since retained earnings tend to be reflected in the price of corporate shares, capital gains in AGI that come from corporate stock are also removed to avoid double counting.[7]
- Family economic income attempts to measure capital income correctly by removing the inflation component of nominal income and additional amounts of tax preference. It indexes interest receipts and expenses, and capital gains and losses. It replaces tax depreciation with real

economic depreciation, and attempts to adjust for the indexed tax-preference component of intangible drilling costs and percentage depletion allowances.

D. Issues in Defining Family Economic Income

Translating the Haig-Simons concept of income as consumption plus change in net worth into a quantifiable measure for tax analysis presents a number of instances where either the correct theoretical treatment is not clear, where imperfections in the data require compromises to be made, or where the correct conceptual treatment of income produces a mismatch in the timing of income and taxes reported. In the areas discussed below, the approach reflected in FEI may not be the only correct one, but a better one is not obvious.

1. Pensions

Pension benefits appear in FEI on an accrual basis; that is, a worker is credited with receiving income as the employer contributes to the pension fund and as that fund earns income. In this way, pensions are treated just like other income that is received currently, but saved. Conversely, pensions are not counted as income as they are received, since the pension benefits represent withdrawals of past earnings, rather than current income. Taxes are attributed to taxpayers at the time they are paid. This failure to attribute taxes to holders of tax-deferred pension plans until the time of withdrawal, even though no income is recognized then, can produce the anomalous result that tax is collected from those who have little or no current "income," especially the elderly. It understates the taxes of workers receiving the employer contributions or earnings on their pension funds by failing to recognize their future tax liability.

The treatment of pensions in FEI also makes no distinction between vested and nonvested workers, nor between contributions to defined benefit or defined contribution plans. Ignoring vesting would overstate the income of younger workers, who are less likely to be vested. However, since studies indicate that most workers with employer pension contributions ultimately vest, this approach is reasonable for most workers and avoids attributing all the past contributions whenever vesting occurs. Treating employer contributions and earnings on defined benefit plans in the same manner as additions to defined contribution plans mismeasures the income associated with defined benefit plans in many cases. On average, the value of additions to defined benefit plans probably equals the amount of the additions, but the value may differ substantially from the amount of the addition, depending on the circumstances of the particular plan and worker.

These problems with the treatment of pensions–the mismatch in the timing of pension income and taxes, and the lack of a distinction between vested and nonvested workers or between defined benefit and defined contribution plans–arise because family economic income is an annual measure rather than a lifetime measure. On a lifetime basis, pension income and taxes would be matched appropriately. Employer contributions for workers who did not vest in a plan would not be counted as income. And the total additions to a defined benefit plan would equal the benefits received.

In an annual measure of income, pension income could be treated in several alternative ways, but none of them seem satisfatory either. The simplest approach would be to include pension income as it was received in retirement, on a realized basis instead of on an accrual basis. This would eliminate the three problems noted above, but it would seriously understate Haig-Simons income to the extent employer contributions for pensions and earnings on pension funds represented increases in net worth. A second alternative would be to include pension income both as it accrued and when it was received. This would alleviate the mismatch between income and taxes for retirees, but would overstate the aggregate amount of pension "income" in the economy and not solve the income measurement problems for current workers. A third approach would count both income and taxes on an accrual basis, associating deferred taxes with deferred income and removing from tax liability the taxes actually paid on pension benefits received. This would solve the mismatch of taxes and income, but calculating deferred taxes would involve uncertainty about the future tax system and the tax rate the individual worker would face.

2. Corporate Income

Allocating corporate income to individuals is one of the more controversial parts of FEI. Many people, particularly noneconomists, implicitly subscribe to the notion of a "corporate veil" and view the corporation as distinct from its stockholders. To them, corporate earnings do not belong to individuals until they are distributed. Others who see through the corporate veil may still disagree with the way FEI allocates corporate income among individuals. Rather than distributing the income on the basis of the direct and indirect ownership of stock (as FEI does), other assumptions of the incidence of the corporate tax would imply distributing the income on the basis of ownership of capital in general, or consumption, or labor income. For the long run, a corporate tax borne by all capital is a particularly popular view.[8]

Whether the incidence of corporate income and the corporate tax falls on stockholders or on owners of all capital, a problem arises with the share allocated to defined benefit pension plans. Should the corporate stock owned by defined benefit plans be attributed to the workers with rights to the pension benefits, or to the owners of the firms sponsoring the pension plans? If corporate income or taxes change, the firm's contribution to the plan changes but not the pension benefits. This suggests that the corporate income and taxes allocated to defined benefit pension plans should be ascribed to the firm and not to the workers with rights to the plan. However, if the firm holds the worker's total compensation fixed, it would increase or decrease nonpension income in response to changes in net corporate income of the pension fund, and the incidence of corporate income and taxes would appropriately fall on the worker. Further analysis of defined benefit plans is necessary before this issue can be resolved.

The inclusion of corporate income in FEI also leads to a possible mismatch between income and taxes in two respects. The first mismatch arises because capital gains on corporate stock are removed from a taxpayer's AGI when corporate income is attributed to the return (in order to avoid double counting of retained earnings in the aggregate), but the taxes on those gains remain. The taxes appear as realized, but the corporate income is included in FEI as it accrues. The result is that some taxpayers may have large tax liabilities from capital gains that accrued over many years but a relatively small amount of corporate income accruing in the tax year.

A second mismatch may occur because corporate taxes have generally not been included in distributional analyses even though the income classifier includes corporate income.[9] Whether or not this treatment is viewed as inconsistent depends in part on the question being addressed and on the role assigned to the income classifier. If the question is the distribution of Federal income taxes (or the effects of the Tax Reform Act of 1986), then the answer should include both corporate and individual income tax burdens. However, this is not the only approach useful in tax policy analysis. Examining individual income taxes alone provides an extremely important part of the distributional picture, and one that is more clearly defined and less controversial than the combined effect of individual and corporate taxes. Furthermore, an income classifier is intended to discriminate among people on the basis of their levels of economic well-being, to put people into the "right boxes" for analyzing the impact of any taxes: individual, consumption, even social security taxes. Including corporate income in the classifier but not in the taxes being examined adds no inconsistency to that analysis.

Corporate taxes can of course be distributed along with individual taxes, given an incidence assumption. Table 3.3 presents the distribution of family economic income, corporate income (the portion not attributable to foreigners, government or nonprofit institutions) as included in FEI, and the distributions of pre-TRA income tax liabilities with and without corporate taxes, assuming that corporate taxes are borne in proportion to the ownership of corporate income. The table shows that although corporate income is more concentrated in higher income classes than family economic income, combining corporate taxes with individual income taxes has relatively little effect on the distribution of the tax burden. From columns (1) and (2), the top two income classes receive 26 percent of all corporate income but only 12 percent of FEI; families with incomes of $20,000 or less receive only 7.5 percent of corporate income but 15 percent of FEI. In spite of this disparity between the two distributions of income, columns (3) and (4) show that the distributions of individual income taxes and individual plus corporate income taxes are quite similar. This results from the fact that corporate income happens to be distributed much like individual income tax liabilities, and from the

Table 3.3 **DISTRIBUTIONAL COMPARISONS OF CORPORATE AND FAMILY ECONOMIC INCOME, AND INDIVIDUAL AND CORPORATE INCOME TAX LIABILITIES**
(1983 income levels, 1988 law)

Family Economic Income ($1,000's)	FEI	Corporate Income	Distribution of 1988 Pre-TRA Law Tax Liabilities: Individual	Individual & Corporate*
	(1)	(2)	(3)	(4)
			(Percentage)	
< 0	-.24	0.23	0.10	0.12
0 - 10	3.23	1.24	0.47	0.58
10 - 15	5.28	2.29	1.67	1.77
15 - 20	6.85	3.76	3.22	3.30
20 - 30	16.08	10.65	10.51	10.53
30 - 50	29.88	23.26	26.29	25.83
50 - 100	26.85	31.89	30.98	31.12
100 - 200	6.15	12.70	10.63	10.94
200+	5.89	13.99	16.13	15.81
Total	100.0	100.0	100.0	100.0

*Assumes corporate income taxes are distributed in proportion to corporate income in family economic income.

fact that corporate income taxes only amount to about 20 to 25 percent of individual income taxes. The inclusion of corporate taxes is likely to have a bit more effect on the conclusions about the distributional consequences of the Tax Reform Act of 1986, however, because individual taxes were lowered while corporate taxes were raised.

3. Capital Gains

In theory, Haig-Simons income includes capital gains as they accrue on all assets in the economy, adjusted for changes in purchasing power. Unfortunately, the necessary data on accruals on many types of assets are not available at the individual level. Tax returns provide data on realizations of gains on various types of assets, with information necessary to adjust for inflation during the holding period. Realized gains, however, may not reflect accruals very well since tax laws clearly influence the timing of the realization of gains and losses. FEI therefore contains only a proxy for an ideal measure of real accrued gains.

For owners of corporate stock, retained earnings adjusted for inflation should represent real accruing capital gains. The only real gains or losses that would not be reflected in real retained earnings would be "unexpected gains." Theoretically, there is no reason why in the aggregate these unanticipated gains and losses should be either positive or negative, so we assume that they net out to zero. FEI includes real gains or losses on corporate stock on an accrual basis in the allocation of corporate income. Unfortunately, this approach eliminates the difference between successful and unsuccessful investors.

For noncorporate assets, gains were estimated on a realization basis, in spite of the influence that tax laws have on decisions to realize gains, for two main reasons. First, there is no evidence on ownership of noncorporate assets that is as reliable as the receipt of dividends from corporate stock. Second, there is no measure of accruing gains on noncorporate and personal assets comparable to retained earnings on corporate stock. Family economic income, therefore, includes estimates of realized capital gains, adjusted for inflation over the estimated holding periods, on noncorporate assets identified as securities other than corporate stock, real estate, livestock, and "other assets." In an attempt to offset some of the distortion in the timing of realizations caused by the tax laws, FEI followed the Tax Code's example and limited total real losses to $3,000 per return.

4. Implicit Income

Ideally, economic income would be measured before any effects of distorting taxation. Since markets tend to equalize after-tax rates of return, tax preferences can depress the pre-tax rate of return on a preferred asset, and comparatively heavy taxation can raise the pre-tax rate of return, relative to the returns that would prevail under a system of neutral taxation. This implies that the observed earnings on assets bearing different rates of tax do not necessarily reflect true pre-tax earnings, and that in computing economic income, adjustments should be made to measured incomes (with implicit income added or subtracted) for the effects of the tax structure on before-tax returns. For example, the tax exemption on municipal bonds lowers the interest earned on those holdings. The owners of the bonds receive implicit income that ideally would be counted in economic income. (They pay implicit taxes as well.) Similarly, if corporate assets are heavily taxed, then corporate income would be lower in the absence of distorting taxation. The distribution of this change in income among individuals depends on the incidence of the corporate tax that is adopted. For consistency, the incidence assumptions used to adjust pre-tax earnings should coincide with the assumptions used to distribute taxes.

In practice, this type of adjustment to pre-tax earnings was not made in computing family economic income because of the complexities in modeling the rates of return that would prevail in a world with neutral taxation.

IV. EXPANDED INCOME AND MODIFIED EXPANDED INCOME

While the Treasury Department has used family economic income for analyzing recent tax proposals, the Joint Committee on Taxation (JCT) developed its own broad measure of income. Understanding the Joint Committee's income concept ("modified expanded income" or MEI) is particularly important since the official congressional estimates of the distributional impact of the Tax Reform Act of 1986, and the House and Senate proposals leading up to it, were based on MEI.

A. Definitions

Since tax analysts have long recognized the limitations of using AGI as an income classifier, the Treasury Department, the Joint Committee, and others used "expanded income" through much of the 1970's as a measure that improved upon AGI and that could be derived solely from information reported on tax returns. Expanded income adds back identifiable items of tax preference that are excluded from AGI but that are subject to the minimum tax, and then subtracts investment interest deductions up to the amount of investment income. The tax preferences are primarily the excluded portion of nominal capital gains, and preferences such as excess amounts of depreciation, intangible drilling costs, and percentage depletion, for taxpayers filing minimum tax returns. (The preferences are measured as the excess over tax amounts, not over economic amounts.)

Modified expanded income is similar to expanded income in that it adds back tax preferences reported on minimum tax returns and the excluded portion of capital gains; however, MEI makes no adjustment for investment interest expenses. MEI makes further adjustments to AGI, as shown in Table 3.4. Modified expanded income adds in some of the income of nonfilers. It adds back to AGI the IRA and second-earner deductions. It includes estimates of tax-exempt interest, employer contributions for health and life insurance, nontaxable social security benefits and some other transfers. MEI excludes losses arising from rental and royalty properties, estates, small business corporations, and from partnership interests that appear to be "passive." These exclusions are based on the fact that investments in certain passive activities may result in losses for tax purposes that do not represent real economic losses. Rather than attempt to separate real from tax losses, MEI simply sets all these passive losses equal to zero and excludes them.

Modified expanded income applies to the traditional unit of tax analysis –the tax return–with two exceptions: the analyses exclude taxpayers under age 16, and they include nonfilers as well as filers. The reason for excluding young taxpayers is that:

> "[t]his reflects the view that income of children under 16, who tend to have relatively low incomes, should, if possible, be added to that of

Table 3.4 DERIVATION OF MODIFIED EXPANDED INCOME FROM AGI, 1983

	(Millions)
AGI, 1983 levels defined by pre-TRA 1986 law	$1,939,430
+ Partial income of nonfilers[a]	10,604
+ Adjustments: IRA's, second-earner deduction, other	53,156
+ Losses on:	
Rents	25,333
Passive partnerships	25,988
Royalties, estates, SBC's, misc.	8,042
+ Excluded capital gains	73,084
+ Minimum tax preferences, adjusted	5,452
+ Tax-exempt interest	11,005
+ Transfers:	
Nontaxable social security benefits	156,258
Nontaxable workman's compensation	11,868
Nontaxable unemployment compensation	15,909
+ Employer contributions for health & life insurance	83,905
+ Earnings on life insurance funds	13,415
+ Miscellaneous, including dividend and interest exclusion	5,360
Equals: Modified Expanded Income. 1983	$2,439,877

[a] This reflects the income of nonfilers that could be estimated from the Census Bureau's Current Population Survey.

their parents in order to achieve a more accurate measure of the distributional impact of tax change." (Joint Committee on Taxation (1985).)

B. Comparison Between Modified Expanded Income and Family Economic Income

The major differences between MEI and FEI stem from the fact that FEI attempts to quantify a broad definition of income that is theoretically sound but difficult to estimate. whereas MEI extends AGI in modest ways that can be estimated with greater ease and confidence. To begin, FEI is a more comprehensive–and larger–measure of income than MEI: $2.9 trillion vs. $2.4 trillion, respectively. As Table 3.5 shows. FEI includes more sources of income than does MEI.

FEI attempts to separate the real economic values from the amounts of income or loss reported for tax purposes. It does so by adjusting all returns with business income for estimated amounts of the major tax preferences, such

Table 3.5 **DERIVATION OF FAMILY ECONOMIC INCOME FROM MODIFIED EXPANDED INCOME**

	(Millions)
Modified Expanded Income	$2,439,877
+ Transfers:	
Welfare & Food Stamps	34,599
Railroad retirement	6,119
Veterans' benefits	12,731
+ Pensions:	
Employer contributions & profit sharing	97,737
Earnings on pension, IRA, Keogh funds	98,838
Taxable Pensions	-77,496
+ Unreported income of filers & nonfilers	240,194
+ Real net rent on owner-occupied homes	55,357
+ Real pre-tax corporate economic income	223,617
- Dividends before exclusion	-49,587
- Dividend earnings of pension and life insurance funds	-19,410
+ Preference adjustments:	
Passive losses	-59,363
Excess depreciation (tax depreciation minus economic depreciation)	11,426
+ Inflation adjustment for net interest of noncorporate business	15,972
+ Net adjustment in other preferences	-3,155
+ Capital gains adjustments:	
Realized capital gains	-117,678
Real net capital gains (except on corporate stock and other securities)	21,665
+ Inflation adjustment for interest received	-88,012
+ Netting of other (carryover) losses	12,391
+ Miscellaneous (including other fringe benefits, military benefits, Keogh contributions)	26,387
Equals: Family Economic Income	$2,882,085

as accelerated depreciation and intangible drilling costs, that create losses for tax purposes but that are not real economic losses. Although the FEI approach cannot claim to adjust every tax return appropriately, on average and overall it removes the amount of tax preferences independently estimated to be present. MEI, on the other hand, disallows all losses in categories where tax shelters are most heavily concentrated. This approach makes no attempt to separate "real" from "artificial" losses individually or overall, and it removes none of the benefit of tax preferences from profitable businesses.

Family economic income attempts to measure Haig-Simons income correctly. Consequently, it adjusts for inflation, raising the income of taxpayers with large interest expenses and lowering the income of many with long-term capital gains and interest income. In addition, FEI attributes corporate income to its shareholders. Modified economic income makes no such allocation.

Family economic income in general relies heavily on estimates of income and adjustments to income ("imputations") from sources other than tax returns, whereas only a few components of MEI are based on imputations: social security and the other transfer benefits, employer contributions, tax-exempt interest, earnings on life insurance funds, and the determination of which partnership losses are passive. MEI reflects a concern with variation added through the imputation process, whereas FEI aims more for the correct expected value of a theoretically sound measure. Capital gains provides an example of the contrasting approaches reflected in FEI and MEI. FEI attempts to include the best feasible estimate of the expected value of real accruing capital gains. Replacing gains on corporate stock with real retained earnings is a theory-based proxy for accruing capital gains but one that omits much of the real variation among stockholders in accruing gains and losses. MEI, on the other hand, maintains the variance reported on tax returns among winning and losing stockholders. However, its inclusion of 100 percent of nominal capital gains will always with certainty overstate the real (after inflation) capital gain.

Beyond the definition of income, FEI and MEI differ in the unit of analysis to which they apply: FEI applies to families, whereas MEI applies to tax units in which the taxpayer is at least 16 years of age. Again, the MEI approach is more certain. Age of the taxpayer is known, whereas the family to which an individual who files his or her own tax return belongs cannot readily be identified. Rather, for FEI a family similar to the one to which the individual is likely to belong must be picked by information from other sources. In spite of the imprecision of "imputing" families to members who file their own tax returns, the income of the related individuals is typically a poor indicator of their standard of living or well-being, even for dependent taxpayers over age 16. Whereas 92 percent of dependent filers have AGI of no more than $10,000, over half live in families with economic income over $50,000. Removing dependent filers under age 16 removes only 6 percent of all dependent filers, as Table 3.6 shows. Most dependent filers are between 16 and 25 years old.

V. IMPLICATIONS OF THE DIFFERENCES BETWEEN FAMILY ECONOMIC INCOME AND MODIFIED EXPANDED INCOME

For all the differences between the income classifiers discussed above, how do the measures differ quantitatively, and what are the implications for tax policy analysis?

Table 3.7 presents a simple comparison of the three income measures, the alternative units of analysis, and the inclusion of nonfilers. It confirms,

Table 3.6 AGE DISTRIBUTION OF DEPENDENT FILERS, 1983

Age	Number (1,000s)	Distribution (percentage)
Under 16	1,101	8.2
16 - 20	6,917	51.2
21 - 25	3,813	28.2
25 - 65	1,329	9.8
65 and over	351	2.6
All	13,509	100.0

Table 3.7 DISTRIBUTION OF RETURNS AND FAMILIES, FILERS AND NONFILERS, UNDER ALTERNATIVE INCOME CLASSIFIERS

(1983 Levels of Income)

Income Class ($1,000s)	All Returns by AGI			Returns Age 16 & over by MEI			Families by FEI		
	Filers (1)	Nonfilers (2)	Total (3)	Filers (4)	Nonfilers (5)	Total (6)	Filers (7)	Nonfilers (8)	Total (9)
				(Percentages)					
< 0	.9	.1	.8	.5	.1	.4	.1	1.0	.3
0 - 10	35.0	99.5	48.4	26.0	93.7	39.7	6.3	50.3	15.6
10 - 15	14.4	.3	11.5	14.9	4.6	12.8	11.7	18.8	13.2
15 - 20	11.3	.1	9.0	12.6	1.1	10.2	12.6	10.8	12.2
20 - 30	16.9	.0	13.4	8.1	.4	6.5	22.8	10.8	20.2
30 - 50	16.1	.0	12.8	19.4	.1	15.5	28.5	6.4	23.8
50 - 100	4.6	.0	3.6	6.8	.0	5.5	15.7	1.7	12.8
100 - 200	.7	.0	.5	.9	.0	.7	1.8	.1	1.5
200+	.1	.0	.1	.3	.0	.3	.5	.0	.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

for example, that the broader the measure of income and the unit of analysis, the higher the distribution of income appears: families classified by economic income (column 9) tend to fall into much higher income classes than do returns of people at least age 16 classified by MEI (column 6), which in turn are in higher income classes than returns from all age groups classified by AGI (column 3). Only 29 percent of all families have economic income under $15,000, while over half the tax units headed by people age 16 or older have MEI below $15,000, and 60 percent of total tax units have AGI below this level. By family economic income $15,000 is clearly a low-income class, whereas it is a middle-income class according to the two other approaches. At the other end of the income scale, 15 percent of the families have economic incomes above $50,000, but only 4 percent of the tax units have that much AGI and only 6.5 percent of the units not headed by children have that much MEI.

Nonfilers clearly lower the distribution of income under each of the three approaches, although less so for family economic income than for the other two measures. This occurs mainly because of the income sources included in FEI but excluded from AGI and MEI, such as means-tested transfer payments and unreported income from the underground economy.

A question that Table 3.7 does not answer is whether the differences in the three approaches stem mainly from the income classifiers or from the unit of analysis. Table 3.8 addresses this issue. Table 3.8 compares the distribution of adult tax units by MEI (column 1) with the distribution of families by

Table 3.8 **DISTRIBUTION OF TAX UNITS AGE 16+ BY MODIFIED EXPANDED INCOME, FAMILIES BY MODIFIED EXPANDED INCOME AND BY ECONOMIC INCOME**
(1983 Levels of Income)

Income Class ($1,000s)	Age 16 & over by MEI (1)	Families by MEI (2)	Families by Economic Income (3)
		(Percentages)	
< 0	0.4	0.3	0.3
0 - 10	39.7	24.1	15.6
10 - 15	12.8	12.7	13.2
15 - 20	10.2	11.8	12.2
20 - 30	6.5	19.3	20.2
30 - 50	15.5	21.1	23.6
50 - 100	5.5	9.1	12.8
100 - 200	0.7	1.2	1.5
200+	.3	.4	.4
Total	100.00	100.00	100.00

MEI and FEI (columns 2 and 3, respectively). The largest differences among the three columns appear in the $0-$10,000 class: 40 percent of the tax units fall in this MEI class, compared to 24 percent of the families, and only 16 percent of the families if classified by FEI instead of MEI. (These figures include nonfilers, but the conclusion is the same for filers alone.) These figures suggest that both the unit of analysis–adult tax unit vs. family–and the income classifier affect the analysis, with the unit of analysis apparently having a slightly larger effect than the choice of income classifier.

The crucial question for tax policy analysis is how do the different approaches to measuring income and classifying people alter the conclusions about tax changes. The answer for the Tax Reform Act of 1986 appears to be that the choice of approach matters a lot.[10]

Table 3.9 compares individual income tax liabilities under 1988 law before and after TRA86 under the three classification approaches, estimated at 1983 levels of income. Under both old and new law, the family economic income approach shows income classes below $50,000 bearing a smaller fraction of the

Table 3.9 **INDIVIDUAL TAX LIABILITIES UNDER 1988 LAW, BEFORE AND AFTER THE TAX REFORM ACT OF 1986, BY ECONOMIC INCOME OF FAMILIES, MODIFIED EXPANDED INCOME OF RETURNS AGE 16 AND OVER, AND AGI OF RETURNS**
(1983 Levels of Income)

Income Class ($1,000s)	AGI of Returns			MEI of Returns Age 16 and over			Economic Income of Families		
	Prior Law	TRA Law	Percent Change	Prior Law	TRA Law	Percent Change	Prior Law	TRA Law	Percent Change
				(Percentages)					
0 - 10	1.9	1.7	-15.6	1.2	1.0	-17.7	.5	.4	-24.3
10 - 15	4.8	4.3	-14.6	3.6	2.8	-25.8	1.7	1.2	-34.1
15 - 20	6.5	6.4	-6.5	5.3	4.9	-13.0	3.2	2.7	-18.9
20 - 30	16.5	16.4	-4.9	14.1	13.8	-6.7	10.5	10.2	-7.1
30 - 50	29.5	29.8	-3.5	28.9	28.6	-5.9	26.3	26.3	-4.8
50 - 100	19.2	20.2	.2	22.5	23.7	.0	31.0	32.3	-.8
100 - 200	8.6	8.7	-3.7	8.9	9.3	-.1	10.6	11.2	.1
200+	12.9	11.9	-12.3	15.4	15.9	-1.8	16.1	15.5	-8.5
Total	100.0	100.0	-4.7	100.0	100.0	4.7	100.0	100.0	-4.7
Addendum:									
Negative Income	.1	.5	.1	.0	.0	.0	.1	.3	.1

tax burden and classes with at least $50,000 of income paying a larger share than either of the other two methods. This pattern is consistent with the conclusion of Table 3.7 that the distribution of income appears higher with the broader measure of income.

In terms of the percentage change in personal tax liabilities, the three approaches provide notably different conclusions at the bottom and the top of the income scale. First, while the lowest income classes receive the largest percentage tax cuts under all three methods, the size of the percentage reductions varies substantially. Classifying families by FEI shows the largest reductions, with the MEI approach next, and the standard method of AGI of returns showing the smallest cuts. This variation probably stems more from the different units of analysis than from the different income classifiers. The increases in the personal exemptions, the zero bracket amounts, and the Earned Income Tax Credit in TRA86 were particularly beneficial to lower-income taxpayers filing joint or head of household returns, while little of the base broadening affected them. Removing the personal exemption on dependent filer returns, on the other hand, tended to increase taxes for dependent filers, who represent a large portion of taxpayers with low AGI, a smaller fraction of taxpayers with low MEI, but who are grouped with their families in the economic income columns.

The second substantial difference in implication of the three approaches appears in the top income class. According to the FEI and AGI approaches, taxpayers with incomes of $200,000 or more receive above-average personal tax cuts, whereas they get below-average cuts under MEI. Differences among the classifiers probably account for more of this contrast than do differences among the units of analysis, since virtually any return in the top class would also belong to a family with very high income.

In particular, the full taxation of capital gains and the passive loss provisions of TRA86, combined with the ways the various income classifiers treat these forms of income, provide much of the explanation. These two provisions broadened the tax base of anyone with capital gains or passive losses and thereby tended to increase their taxes. By treating passive losses and capital gains almost as they are in the new tax law, MEI moves into higher-income classes taxpayers with these forms of income, who also tend to have tax increases. Since pre-TRA AGI includes only 40 percent of nominal capital gains, classifying by AGI puts taxpayers with capital gains (and the associated tax increases) into above-average income classes, but not into as high a class as under MEI. AGI puts taxpayers with passive losses into much lower-income classes than does MEI. The FEI treatment of capital gains (adjusting for inflation and substituting a share of corporate income for realized gains on stock) and passive losses (adjusting all business income, gains as well as losses, for tax preferences) would put taxpayers in much lower classes than does MEI but probably not as low as AGI. Consequently, the general reduction in tax rates benefits the taxpayers in the top FEI and AGI classes much more than base broadening hurts them, whereas the opposite is true for taxpayers classified in the top MEI category.

VI. CONCLUSION

This paper has explained the measure of family economic income, which recent Treasury analyses have used, and compared it to alternative income classifiers. Table 3.9 confirms that the distributional impact of individual income tax reform can vary significantly with, among other things, the income classifier and unit of analysis on which the comparisons are based.

Several implications for policy analysis can be drawn from the disparate pictures of tax reform painted by Table 3.9. First, there is no single "right" way to give quantitative answers to questions about equity. Indeed, not only can the conclusions vary with different income classifiers and units of analysis, the conclusions depend on how the tax laws are modeled (whether behavioral adjustments are incorporated, whether all provisions are included), whether corporate taxes are included or just individual taxes, the year for which the analysis is performed (TRA86 has a number of phase-ins), as well as more technical issues such as the year to which the data base applies (OTA has used 1983 income levels because of the difficulties of extrapolating into the future).

Second, although there is no single right way, it is important for analysts to resolve among themselves as many of the differences in approaches as possible. The alternative is that the choice among approaches would fall to policymakers who lack the background or expertise to judge technical alternatives. The choice of the unit of analysis--family vs. return--may be one exception where the policymaker's sense of the appropriate basis for equity comparisons could be quite useful.

FOOTNOTES

[1] Among standard references are Musgrave (1959) and Goode (1976). Musgrave states on p. 165: "The concept of taxable income which has gained increasing acceptance among fiscal theorists is that of total accretion. Income is defined to equal consumption during a given period, plus increase in net worth. According to this concept, all accretions to wealth are included, in whatever form they are received or from whatever source they accrue."

Recent users of this definition of income include David Bradford (1983), p. 231; and Pechman (1985), p. 11.

[2] Testimony of John E. Chapoton, Assistant Secretary of the Treasury for Tax Policy, before the Senate Finance Committee, September 28, 1982.

[3] For further discussion, see "The Treasury Individual Income Tax Simulation Model," by Cilke and Wyscarver. Chapter 2 in this volume.

[4] Many surveys, including those conducted by the Bureau of the Census, often use the household as the basis of observation. A household is based on living arrangements and can include unrelated individuals living together. The family as used by OTA requires that all members not only live together but also be related. or meet the dependency test in the tax code, or be married filing separate returns. This definition seems appropriate for analyzing tax liabilities.

[5] Since the concept of "family economic income" was developed for *Tax Reform for Fairness, Simplicity, and Economic Growth* in 1984, the adjusted gross income used as the starting point

refers to pre-TRA law. FEI can be derived just as well from AGI under TRA, but some of the adjustments would differ.

[6] See U.S Census Bureau Technical Paper No. 50, *Alternative Methods for Valuing Selected In-Kind Transfer Benefits and Measuring Their Effect on Poverty*, March 1982.

[7] As is discussed in the following section, this adjustment is not precise since it removes realized gains and replaces them with accruing gains.

[8] This view is generally traced to Harberger (1962). For more recent examples, see Pechman (1985) and Feldstein (1987).

[9] Treasury analyses using FEI have been criticized for not including the corporate taxes as part of the individual tax burden. See Ballentine (1986).

[10] This analysis considers changes only to individual income taxes. As indicated above (Section III.D.2 and Table 3.3), OTA can and does analyze distributional effects of tax changes with imputations for corporate taxes paid by each group. Such calculations are not provided here, however, for several reasons. The focus of this paper is the income classifier, not alternative ways to measure changes in tax burdens from tax reform (which could be the subject of a separate paper). Distributions of individual income taxes alone were the standard analyses examined during the tax reform debates. In addition, the incidence of the corporation income tax is still hotly debated by economists. The distribution of taxes is much more sensitive to the assumption chosen than is the distribution of an income measure that includes corporate income.

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4 TABULATIONS FROM THE TREASURY TAX REFORM DATA BASE

James R. Nunns

I. INTRODUCTION

This paper presents tabulations from the Treasury tax reform data base. This data base was the basic starting point for both the Treasury Department's and the Joint Committee on Taxation's analyses of the distributional and revenue consequences of the individual income tax provisions of the Tax Reform Act of 1986 (TRA).

The first section of the paper provides a brief description of how the tax reform data base was constructed. It covers the basic sources of data; file reduction, extrapolation, alignment and merging; and the imputation of additional data items. The second section of the paper provides a description of the tabulations, as well as the tabulations themselves. The tabulations are divided into two sets. The first set covers major tax variables under 1983 law and post-tax reform law (1988 law). The data are for tax returns of filers classified by adjusted gross income class. There are four tables, covering all returns, joint returns, returns of itemizers, and returns of joint itemizers. The second set of tabulations, which consists of a single table, shows the major items in economic income, for families, by economic income class.

II. CONSTRUCTION OF THE TAX REFORM DATA BASE

This section provides a brief description of how the tax reform data base was constructed.[1] The starting point was the Statistics of Income (SOI) stratified random sample of approximately 144,000 individual income tax returns filed for 1981. The SOI file contains extensive data from Forms

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1040, 1040A, and supporting forms and schedules. Data from the Social Security Administration on the age, sex, and social security earnings of each sample return were appended to the file. The file was then reduced to approximately 75,000 returns, using an optimal cluster sampling procedure. The reduction was done to reduce the computational time of tax model runs.

The data were first modified by imputing itemized deductions to nonitemizers (in order to be able to simulate changes in itemized deductions), and to impute the lesser earning spouse's share of wages and salaries (to simulate the second-earner deduction, which was not in effect in 1981). The data were then extrapolated to 1983 levels. The extrapolation was done in two stages. The first, meant to reflect uniform economic growth and inflation, changed return weights and dollar amounts by fixed proportions. In the second stage, weights were changed differentially in order to hit separately determined targets for key variables, including the size distribution of adjusted gross income (AGI).

Data on nonfilers, nontaxable income sources, and the demographic characteristics of the population, were taken from the Current Population Survey (CPS) conducted annually by the Bureau of the Census. The 50,000 record CPS file was first extrapolated from 1982 (the latest year then available) to 1983. Welfare payments received and the number of recipients were simulated based on household characteristics and eligibility requirements in 1983, and other transfer payments were corrected for nonreporting and underreporting to hit national aggregates. Applying tax filing rules to each person age 16 or over in each household, potential tax filing units were constructed on the CPS file. At this stage, the CPS file was divided between potential filers (age 16 and over) and potential nonfilers.

Before merging the SOI and CPS files, it was necessary to "align" them. There were two parts to this alignment. First, additional CPS filers were created from CPS nonfilers in order to make the (weighted) number of CPS filers match the (weighted) number of SOI tax returns (for filers age 16 and over). Second, both the SOI and CPS files were corrected for underreporting and nonreporting of major sources of income.

The SOI filers age 16 and over and CPS filers (by construction, age 16 or over) were then statistically merged, based on a common set of core variables. CPS nonfilers were then appended to this merged file, and the file recombined into families (based on CPS family identifiers). Finally, SOI filers aged under 16 were merged with families having appropriate income and demographic characteristics.

At this point, the data base contained approximately 198,000 records representing 122 million potential tax units, of which 96 million were filers and 26 million nonfilers. The data base also represented the universe of 91 million families in the U.S. in 1983. Each record contained approximately 500 data items based on tax return, SSA. and CPS data.

The final step in constructing the tax reform data base was to impute some 250 additional variables to the file. These variables included employer-provided fringe benefits, the imputed rental value of owner-occupied housing, detail on capital gains, tax-exempt interest received, earnings on pensions and life insurance, shares of pre-tax corporate income, and various consumption items. Among other uses, many of the imputations were necessary to construct the "economic income" classifier used by the Treasury in distributional analyses.

III. TABULATIONS

All of the tabulations presented here are from the tax reform data base, which contains data at 1983 levels. The following discussion is in the same sequence as the tabulations: the 1983 and 1988 law tables by AGI of tax returns and the 1983 table by the economic income of families.

A. 1983 and 1988 Law Tables

There are four tables covering 1983 and 1988 law: Table 4.1A, for all returns; Table 4.1B, for all joint returns; Table 4.2A, for all itemizer returns; and Table 4.2B, for returns of joint itemizers. Conceptually, the 1983 law figures presented in these four tables should match corresponding figures in the SOI publication, Individual Income Tax Returns 1983. As indicated above, however, the tax reform data base was constructed from the 1981 SOI file, and extrapolated to 1983 levels following a reduction in the file. Therefore, the 1983 law figures presented here do not match exactly those in the SOI publication, although the total value of major variables and the distribution of AGI, which were targeted in the extrapolation process, match fairly closely.

The 1988 law figures in these tables reflect the effect of the TRA at the 1983 level and distribution of income, and under the assumption of static behavior (i.e., no behavioral change). Using 1983 as the income year has several implications. Shifts in the size distribution of income and in the mix of income sources within income classes between 1983 and 1988 are not captured in the tabulations. These 1983-88 changes may be particularly important in analyzing certain provisions of the TRA such as those affecting capital gains and passive losses, for which the 1983-88 changes were quite large. Further, 1988 levels of tax parameters such as the standard deduction, exemptions, tax brackets, and phaseout ranges for the earned income credit, IRAs, the 15 percent bracket, and exemptions are all deflated to 1983 levels using the consumer price index (CPI-U). This deflation gives the conceptually correct real value of tax parameters, but to the extent of real growth between 1983 and 1988 may obscure the relative effect on taxpayers of such provisions as the phaseout for deductible IRAs.

The assumption of static behavior is intentional in these tabulations, since different analysts may want to make differing behavioral assumptions.[2] Further, behavioral adjustments appropriate for 1988 would generally not be appropriate for other years, so incorporating such adjustments in the data might limit their usefulness. However, it is important to recognize that

Table 4.1A **ALL RETURNS: Gross Income, Adjustments, Deductions, Exemptions, Taxable Income, and Taxes Under 1983 and 1988 Law (1983 Level and Distribution of Income)**

AGI Class* (000)	Number of Returns (1)	Wages & Salaries Number of Returns (2)	Wages & Salaries Amount (3)	Interest Number of Returns (4)	Interest Amount (5)	Dividends in AGI Number of Returns (6)	Dividends in AGI Amount (7)	Business Income or Loss Number of Returns (8)	Business Income or Loss Amount (9)	Capital Gains in AGI Number of Returns (10)	Capital Gains in AGI Amount (11)	Pensions in AGI Number of Returns (12)	Pensions in AGI Amount (13)
(Number of Returns in 000, Amounts in $ millions)													
1983 Law													
Under 10	34,647	28,943	149,475	11,832	20,558	2,107	3,696	2,667	(286)	1,620	4,273	2,425	8,832
10 - 15	13,907	11,740	143,294	6,083	16,460	1,016	1,845	1,186	4,433	757	1,025	1,864	11,480
15 - 20	10,836	9,462	160,580	5,431	14,276	1,004	2,724	1,128	5,161	787	994	1,301	9,841
20 - 30	16,466	15,119	367,359	9,990	23,740	1,828	4,772	1,898	9,365	1,665	1,825	1,484	12,653
30 - 50	15,358	14,286	518,333	11,644	35,755	2,721	8,334	1,957	15,280	2,403	5,234	1,631	17,119
50 - 100	4,293	3,798	208,398	3,830	25,546	1,799	10,767	791	15,094	1,624	6,882	520	7,892
100 - 200	623	498	49,527	605	9,598	427	6,640	158	6,291	410	5,547	76	1,365
200 & Over	161	130	34,781	159	7,871	130	8,427	45	9,937	126	18,595	17	632
Total	96,293	83,976	1,631,745	49,574	153,803	11,032	47,205	9,830	65,276	9,392	44,375	9,317	69,814
1988 Law													
Under 10	35,166	29,079	149,860	11,832	20,558	2,945	3,998	2,669	(285)	1,533	11,011	2,943	11,612
10 - 15	13,969	11,740	143,294	6,083	16,460	1,473	2,029	1,188	4,433	757	2,756	2,006	12,697
15 - 20	10,850	9,462	160,580	5,431	14,276	1,438	2,891	1,128	5,161	786	2,759	1,380	10,426
20 - 30	16,474	15,119	367,359	9,990	23,740	2,896	5,102	1,898	9,365	1,665	5,454	1,538	13,490
30 - 50	15,363	14,286	518,333	11,644	35,755	4,337	8,923	1,957	15,280	2,408	13,979	1,728	18,021
50 - 100	4,293	3,798	208,398	3,830	25,546	2,268	11,138	791	15,094	1,625	18,111	565	8,444
100 - 200	623	498	49,527	605	9,598	475	6,724	158	6,291	411	14,112	80	1,448
200 & Over	161	130	34,781	159	7,871	139	8,452	45	9,937	126	46,414	18	712
Total	96,900	84,111	1,632,130	49,574	153,803	15,971	49,258	9,834	65,276	9,312	114,597	10,258	76,851

Table 4.1A ALL RETURNS (continued)

AGI Class* (000)	NetRents, Royalties, Partnership, etc., and Farm Income		Social Security Benefits in AGI		Other Gross Income		Total Gross Income		Moving Expense		Employee Business Expense		Two-Earner Deduction	
	No. of Returns (14)	Amount (15)	No. of Returns (16)	Amount (17)	No. of Returns (18)	Amount (19)	No. of Returns (20)	Amount (21)	No. of Returns (22)	Amount (23)	No. of Returns (24)	Amount (25)	No. of Returns (26)	Amount (27)
	(Number of Returns in 000, Amounts in $ millions)													
	1983 Law													
Under 10	3,047	(28,006)			1,849	(9,186)	34,594	149,347	199	263	501	1,352	679	241
10 - 15	1,329	(529)			1,649	1,084	13,907	179,090	296	450	717	1,642	1,195	645
15 - 20	1,354	(490)			2,266	2,378	10,836	195,461	215	309	882	1,705	1,754	1,248
20 - 30	2,480	(362)			5,046	5,466	16,466	424,814	347	720	1,728	3,225	5,116	4,827
30 - 50	3,070	(16)			6,089	5,521	15,358	605,551	324	1,054	2,163	4,428	7,063	8,727
50 - 100	1,645	3,821			1,719	2,992	4,293	281,389	123	625	749	1,997	1,704	2,485
100 - 200	446	5,034			249	1,223	623	85,224	27	221	98	526	129	217
200 & Over	137	7,407			75	991	161	88,639	3	31	19	157	27	56
Total	13,508	(13,141)			18,941	10,470	96,240	2,009,516	1,533	3,671	6,857	15,033	17,666	18,445
	1988 Law													
Under 10	3,066	(18,193)	3	13	13,470	(9,491)	35,116	169,060						
10 - 15	1,331	74	15	19	7,568	1,021	13,969	182,763						
15 - 20	1,358	51	157	157	7,236	2,608	10,850	198,750						
20 - 30	2,480	608	1,482	2,418	13,112	8,563	16,474	433,676						
30 - 50	3,070	1,800	1,793	4,539	13,687	11,597	15,363	623,679						
50 - 100	1,644	7,421	615	1,637	4,144	5,916	4,293	300,065						
100 - 200	446	8,142	111	391	610	2,569	623	98,409						
200 & Over	137	11,041	33	124	160	2,096	161	121,302						
Total	13,531	10,943	4,210	9,298	59,988	24,879	96,850	2,127,702						

Table 4.1A **ALL RETURNS (continued)**

AGI Class* (000)	IRA's No. of Returns (28)	IRA's Amount (29)	Other Adjustments No. of Returns (30)	Other Adjustments Amount (31)	Total Adjustments No. of Returns (32)	Total Adjustments Amount (33)	Adjusted Gross Income (AGI) No. of Returns (34)	Adjusted Gross Income (AGI) Amount (35)	No. of Non-itemizrs (36)	Amount of Standard Deduction (37)	No. of Itemizrs (38)	Amount of Excess Itemized Deductions (39)	Total No. of Exemp-tions (40)	Value of Exemp-tions (41)
(Number of Returns in 000, Amounts in $ millions)														
1983 Law														
Under 10	608	1,021	1,226	2,556	2,464	5,434	34,593	143,914	32,105		2,542	7,968	60,620	60,620
10 - 15	977	1,996	1,213	1,082	3,194	5,814	13,907	173,276	10,931		2,977	11,211	32,113	32,113
15 - 20	1,250	2,638	1,242	663	3,679	6,563	10,836	188,899	6,965		3,872	12,830	27,992	27,992
20 - 30	2,892	6,567	2,402	1,335	8,233	16,674	16,466	408,141	7,137		9,330	38,021	47,960	47,960
30 - 50	4,960	12,336	2,950	2,286	10,605	28,804	15,358	576,749	3,021		12,338	71,075	50,175	50,175
50 - 100	2,496	6,288	1,161	2,185	3,364	13,573	4,293	267,816	318		3,975	41,388	14,525	14,525
100 - 200	361	953	190	991	462	2,890	623	82,333	33		590	13,224	2,147	2,147
200 & Over	107	260	44	414	125	917	161	87,722	7		155	12,804	560	560
Total	13,649	32,060	10,427	11,512	32,126	80,668	96,239	1,928,850	60,516		35,778	208,521	236,092	236,092
1988 Law														
Under 10	339	496	956	1,185	1,252	1,682	35,116	167,538	33,379	98,483	1,788	12,914	56,279	70,576
10 - 15	502	914	1,117	648	1,556	1,562	13,969	181,395	11,594	38,765	2,376	16,018	29,100	46,038
15 - 20	614	1,138	1,210	578	1,741	1,716	10,850	197,236	8,143	28,197	2,707	17,706	25,992	41,859
20 - 30	1,437	2,769	2,402	1,335	3,615	4,104	16,474	429,954	9,378	34,644	7,096	50,746	45,953	74,304
30 - 50	1,847	2,435	2,950	2,286	4,431	4,721	15,363	619,479	5,047	20,133	10,317	88,521	48,440	78,557
50 - 100	380	434	1,161	2,185	1,442	2,619	4,293	297,682	630	2,578	3,663	46,839	13,746	22,282
100 - 200	44	62	190	991	222	1,053	623	97,416	46	192	577	13,614	1,941	3,148
200 & Over	10	16	44	414	51	430	161	120,890	10	43	151	12,090	496	805
Total	5,173	8,265	10,029	9,621	14,308	17,886	96,850	2,111,590	68,226	223,036	28,675	258,443	221,948	337,569

Table 4.1A ALL RETURNS (continued)

AGI Class* (000)	Taxable Income		Taxable Income Less ZBA		Tax Before Credits		Credits		Alternative Minimum Tax (AMT)		Earned Income Credit (EIC)		Net Income Tax Liability	
	No. of Returns (42)	Amount (43)	No. of Returns (44)	Amount (45)	No. of Returns (46)	Amount (47)	No. of Returns (48)	Amount (49)	No. of Returns (50)	Amount (51)	No. of Returns (52)	Amount (53)	No. of Returns (54)	Amount (55)
	(Number of Returns in 000, Amounts in $ millions)													
	1983 Law													
Under 10	29,536	112,771	19,428	53,156	19,403	6,705	1,192	234	14	253	6,208	1,770	22,428	4,972
10 - 15	13,650	131,241	13,387	94,647	13,397	13,514	1,894	581	7	38	0	0	13,232	12,990
15 - 20	10,789	148,359	10,716	117,710	10,716	18,237	1,992	690	4	23	0	0	10,534	17,607
20 - 30	16,420	322,522	16,373	272,667	16,371	46,734	4,213	1,311	18	69	0	0	16,265	45,542
30 - 50	15,339	455,734	15,328	405,938	15,328	80,804	5,272	1,850	77	293	0	0	15,300	79,307
50 - 100	4,280	212,122	4,278	198,047	4,277	51,674	1,941	1,341	108	749	0	0	4,278	51,149
100 - 200	620	67,088	620	65,064	620	23,265	390	848	51	710	0	0	622	23,157
200 & Over	160	74,522	160	74,001	160	34,360	123	975	20	1,251	0	0	161	34,674
Total	90,794	1,524,360	80,291	1,281,230	80,273	275,293	17,017	7,829	299	3,386	6,207	1,771	82,822	269,398
	1988 Law													
Under 10	18,895	56,737			18,907	9,206	969	118	30	228	6,603	3,838	24,196	5,482
10 - 15	12,873	83,574			12,883	12,652	1,707	377	2	3	3,788	1,080	13,621	11,200
15 - 20	10,738	109,883			10,738	16,698	1,751	386	5	8	274	8	10,694	16,312
20 - 30	16,394	270,637			16,394	43,794	3,596	741	9	18	0	0	16,381	43,067
30 - 50	15,353	432,420			15,353	77,692	4,311	966	30	57	0	0	15,353	76,778
50 - 100	4,287	226,162			4,287	51,455	1,710	546	57	99	0	0	4,288	51,001
100 - 200	622	80,538			622	22,323	371	336	43	123	0	0	623	22,107
200 & Over	161	108,052			161	30,421	121	314	18	208	0	0	161	30,312
Total	79,322	1,368,003			79,345	264,242	14,535	3,785	195	745	10,665	4,926	85,318	256,258

* AGI as defined under 1983 law.

Table 4.1B JOINT RETURNS: Gross Income, Adjustments, Deductions, Exemptions, Taxable Income and Taxes Under 1983 and 1988 Law (1983 Level and Distribution of Income)

AGI Class* (000)	Number of Returns (1)	Wages & Salaries		Interest		Dividends in AGI		Business Income or Loss		Capital Gains in AGI		Pensions in AGI	
		Number of Returns (2)	Amount (3)	Number of Returns (4)	Amount (5)	Number of Returns (6)	Amount (7)	Number of Returns (8)	Amount (9)	Number of Returns (10)	Amount (11)	Number of Returns (12)	Amount (13)
(Number of Returns in 000, Amounts in $ millions)													
1983 Law													
Under 10	6,676	4,669	36,105	3,246	7,460	389	1,279	1,556	(1,202)	670	3,378	1,211	5,063
10 - 15	5,312	4,134	49,651	2,796	8,582	512	837	889	3,276	531	907	1,176	7,274
15 - 20	5,497	4,769	81,391	2,823	8,318	433	914	873	3,811	470	714	832	6,079
20 - 30	11,191	10,453	258,636	6,774	14,012	937	1,995	1,640	8,104	1,160	1,381	996	8,204
30 - 50	13,266	12,490	460,143	9,982	26,523	2,074	5,510	1,781	13,445	1,914	3,753	1,380	14,897
50 - 100	3,862	3,499	193,146	3,460	20,881	1,541	7,441	734	13,616	1,389	5,431	475	7,433
100 - 200	547	455	45,793	533	7,901	370	5,044	144	5,699	357	4,203	64	1,137
200 & Over	141	119	31,741	139	6,496	114	6,775	40	8,687	110	15,659	15	548
Total	46,492	40,588	1,156,606	29,754	100,174	6,372	29,796	7,656	55,436	6,601	35,427	6,150	50,635
1988 Law													
Under 10	6,742	4,691	36,178	3,246	7,460	715	1,385	1,556	(1,202)	631	8,590	1,258	5,388
10 - 15	5,335	4,134	49,651	2,796	8,582	778	963	890	3,276	531	2,351	1,199	7,533
15 - 20	5,502	4,769	81,391	2,823	8,318	713	1,018	873	3,811	470	2,034	837	6,167
20 - 30	11,196	10,453	258,636	6,774	14,012	1,764	2,226	1,640	8,104	1,160	4,054	1,001	8,327
30 - 50	13,266	12,490	460,143	9,982	26,523	3,599	6,030	1,781	13,445	1,917	10,076	1,380	14,897
50 - 100	3,862	3,499	193,146	3,460	20,881	1,992	7,786	734	13,616	1,390	14,363	475	7,433
100 - 200	547	455	45,793	533	7,901	414	5,122	144	5,699	358	10,722	64	1,137
200 & Over	141	119	31,741	139	6,496	123	6,798	40	8,687	110	39,085	15	548
Total	46,590	40,611	1,156,679	29,754	100,174	10,099	31,330	7,658	55,436	6,568	91,274	6,230	51,430

Table 4.1B JOINT RETURNS: Continued

AGI Class* (000)	NetRents,Royalties, Partnership, etc., and Farm Income		Social Security Benefits in AGI		Other Gross Income		Total Gross Income		Moving Expense		Employee Business Expense		Two-Earner Deduction	
	No. of Returns (14)	Amount (15)	No. of Returns (16)	Amount (17)	No. of Returns (18)	Amount (19)	No. of Returns (20)	Amount (21)	No. of Returns (22)	Amount (23)	No. of Returns (24)	Amount (25)	No. of Returns (26)	Amount (27)
						(Number of Returns in 000, Amounts in $ millions)								
							1983 Law							
Under 10	1,721	(21,921)			977	(8,386)	6,673	21,776	71	106	247	764	679	241
10 - 15	847	(769)			753	409	5,312	70,167	157	257	307	846	1,195	645
15 - 20	876	(474)			1,367	627	5,497	101,380	113	189	534	1,222	1,754	1,248
20 - 30	1,930	(871)			3,745	3,263	11,191	294,721	254	506	1,247	2,585	5,116	4,827
30 - 50	2,597	(904)			5,566	5,050	13,266	528,415	281	968	1,898	3,816	7,063	8,727
50 - 100	1,446	2,895			1,608	2,522	3,862	253,364	112	584	696	1,822	1,704	2,485
100 - 200	399	4.128			224	934	547	74,838	27	220	91	476	129	217
200 & Over	120	5,931			67	864	141	76,700	3	29	18	141	27	56
Total	9.935	(11,986)			14,307	5,282	46,489	1,421,361	1,017	2,858	5,038	11,671	17,666	18,445
							1988 Law							
Under 10	1,728	(15,568)	3	12	4,527	(8,176)	6,739	34,054						
10 - 15	849	(253)	11	16	3,710	528	5,335	72,632						
15 - 20	876	(39)	54	90	4,271	917	5,502	103,617						
20 - 30	1,930	(6)	838	1,327	9,490	5,490	11,196	300,840						
30 - 50	2,597	631	1,476	3,891	12,086	10,959	13,266	542,702						
50 - 100	1,445	6,034	493	1,340	3,760	5,566	3,862	268,824						
100 - 200	398	6,917	88	323	540	2,214	547	85,505						
200 & Over	120	9,079	26	101	140	1,920	141	104,352						
Total	9,943	6,795	2,989	7,100	38,525	19,418	46,588	1,512,526						

Table 4.1B JOINT RETURNS: Continued

	IRA's		Other Adjustments		Total Adjustments		Adjusted Gross Income (AGI)							
AGI Class* (000)	No. of Returns (28)	Amount (29)	No. of Returns (30)	Amount (31)	No. of Returns (32)	Amount (33)	No. of Returns (34)	Amount (35)	No. of Non-itemizrs (36)	Amount of Standard Deduction (37)	No. of Itemizrs (38)	Amount of Excess Itemized Deductions (39)	Total No. of Exemptions (40)	Value of Exemptions (41)
(Number of Returns in 000, Amounts in $ millions)														
1983 Law														
Under 10	370	695	600	1,637	1,527	3,442	6,673	18,334	5,799		877	3,588	22,774	22,774
10 - 15	501	1,207	549	602	2,028	3,557	5,312	66,610	4,059		1,253	5,242	18,737	18,737
15 - 20	793	1,963	739	361	2,705	4,983	5,497	96,397	3,430		2,067	8,044	19,416	19,416
20 - 30	2,348	5,678	1,659	853	6,991	14,448	11,191	280,274	4,895		6,296	27,279	39,686	39,686
30 - 50	4,675	11,873	2,520	1,747	9,936	27,103	13,266	501,311	2,584		10,682	61,610	46,842	46,842
50 - 100	2,404	6,138	1,051	1,808	3,183	12,833	3,862	240,531	291		3,571	37,016	13,803	13,803
100 - 200	349	935	171	825	435	2,655	547	72,183	29		518	11,529	2,017	2,017
200 & Over	102	253	39	325	117	802	141	75,897	6		135	10,852	522	522
Total	11,541	28,742	7,330	8,159	26,923	69,824	46,488	1,351,537	21,092		25,400	165,160	163,798	163,798
1988 Law														
Under 10	196	319	417	691	599	1,012	6,739	33,133	5,940	25,510	802	6,679	20,325	32,935
10 - 15	294	574	476	300	724	874	5,335	71,859	4,272	18,434	1,063	8,040	16,561	26,862
15 - 20	435	877	707	276	1,093	1,153	5,502	102,609	3,873	16,340	1,629	11,852	18,027	29,240
20 - 30	1,287	2,532	1,659	852	2,754	3,384	11,196	297,762	6,230	25,990	4,966	37,760	38,289	62,091
30 - 50	1,783	2,342	2,520	1,747	3,948	4,089	13,266	539,061	4,314	18,082	8,952	77,621	45,386	73,617
50 - 100	370	417	1,051	1,808	1,324	2,226	3,862	266,813	558	2,384	3,304	42,173	13,137	21,309
100 - 200	41	57	171	825	201	882	547	84,677	39	172	508	11,931	1,840	2,985
200 & Over	9	15	39	325	46	340	141	104,029	9	40	132	10,250	468	758
Total	4,415	7,134	7,041	6,826	10,689	13,960	46,588	1,499,942	25,233	106,954	21,357	206,301	154,035	249,797

Table 4.1B JOINT RETURNS: Continued

AGI Class* (000)	Taxable Income		Taxable Income Less ZBA		Tax Before Credits		Credits		Alternative Minimum Tax (AMT)		Earned Income Credit (EIC)		Net Income Tax Liability	
	No. of Returns (42)	Amount (43)	No. of Returns (44)	Amount (45)	No. of Returns (46)	Amount (47)	No. of Returns (48)	Amount (49)	No. of Returns (50)	Amount (51)	No. of Returns (52)	Amount (53)	No. of Returns (54)	Amount (55)
	(Number of Returns in 000, Amounts in $ millions)													
	1983 Law													
Under 10	4,980	18,437	2,773	4,856	2,774	561	258	42	10	215	2,824	797	4,596	(53)
10 - 15	5,201	43,141	4,981	25,754	4,985	3,316	814	218	5	26	0	0	4,863	3,136
15 - 20	5,465	69,115	5,394	50,610	5,394	7,083	1,272	458	3	15	0	0	5,237	6,671
20 - 30	11,162	213,471	11,126	175,560	11,124	27,865	3,330	1,112	13	48	0	0	11,022	26,849
30 - 50	13,253	393,042	13,242	348,001	13,242	67,269	4,774	1,706	46	218	0	0	13,215	65,836
50 - 100	3,852	189,873	3,850	176,779	3,850	45,216	1,778	1,203	90	631	0	0	3,851	44,705
100 - 200	545	58,734	545	56,882	545	20,142	354	778	38	507	0	0	546	19,900
200 & Over	140	64,662	140	64,186	140	29,698	110	844	16	1,044	0	0	141	29,933
Total	44,598	1,050,475	42,050	902,627	42,054	201,152	12,690	6,361	223	2,705	2,824	797	43,472	196,978
	1988 Law													
Under 10	1,742	7,137			1,743	1,463	189	10	22	138	3,145	1,822	4,597	(228)
10 - 15	4,554	20,429			4,558	3,149	708	96	1	2	2,113	583	5,167	2,473
15 - 20	5,414	45,463			5,414	6,868	1,102	230	4	5	175	5	5,384	6,638
20 - 30	11,137	172,150			11,137	26,055	2,844	608	8	17	0	0	11,126	25,462
30 - 50	13,259	369,872			13,259	64,132	3,903	904	19	49	0	0	13,259	63,273
50 - 100	3,858	201,094			3,858	44,902	1,559	481	47	83	0	0	3,858	44,498
100 - 200	546	69,651			546	19,263	336	310	36	105	0	0	547	19,053
200 & Over	141	93,072			141	26,219	108	268	15	165	0	0	141	26,113
Total	40,651	978,869			40,656	192,050	10,750	2,908	151	564	5,433	2,410	44,079	187,281

* AGI as defined under 1983 law.

Table 4.2A **ALL ITEMIZER RETURNS: Gross Income, Adjustments, Deductions, Exemptions, Taxable Income and Taxes Under 1983 and 1988 Law (1983 Level and Distribution of Income)**

		Wages & Salaries		Interest		Dividends in AGI		Business Income or Loss		Capital Gains in AGI		Pensions in AGI	
AGI Class* (000)	Number of Returns (1)	Number of Returns (2)	Amount (3)	Number of Returns (4)	Amount (5)	Number of Returns (6)	Amount (7)	Number of Returns (8)	Amount (9)	Number of Returns (10)	Amount (11)	Number of Returns (12)	Amount (13)
(Number of Returns in 000, Amounts in $ millions)													
1983 Law													
Under 10	2,542	1,209	12,371	1,820	4,925	535	1,611	521	971	400	901	392	1,407
10 - 15	2,977	2,284	28,109	1,746	4,894	325	722	534	1,983	289	406	620	4,233
15 - 20	3,872	3,154	54,003	2,365	6,028	575	1,790	671	3,153	465	655	619	5,163
20 - 30	9,330	8,506	211,972	6,128	12,844	1,093	3,333	1,385	6,833	1,079	1,369	811	6,677
30 - 50	12,338	11,572	426,829	9,485	25,981	2,169	6,403	1,682	12,863	2,024	3,696	1,247	12,793
50 - 100	3,975	3,557	196,831	3,543	22,016	1,653	9,957	740	13,887	1,516	6,361	448	6,708
100 - 200	590	475	47,517	573	8,904	407	6,420	150	5,887	392	5,245	71	1,299
200 & Over	155	125	33,679	152	7,479	125	8,265	44	9,698	121	17,803	17	618
Total	35,778	30,881	1,011,310	25,811	93,072	6,883	38,499	5,726	55,277	6,285	36,436	4,225	38,898
1988 Law													
Under 10	1,788	970	12,141	1,184	3,739	438	1,016	499	(1,872)	244	2,865	292	1,345
10 - 15	2,376	1,901	24,252	1,348	3,849	362	583	456	1,644	240	726	461	3,035
15 - 20	2,707	2,266	39,865	1,687	3,691	523	1,205	530	2,441	305	1,348	427	3,677
20 - 30	7,096	6,520	164,180	4,737	8,933	1,356	2,560	1,137	5,600	812	3,422	596	4,820
30 - 50	10,317	9,792	366,079	7,908	19,076	2,960	5,393	1,426	10,897	1,631	6,972	980	10,236
50 - 100	3,663	3,317	185,410	3,257	18,842	1,930	9,298	684	12,840	1,383	14,868	430	6,376
100 - 200	577	469	47,260	560	8,437	443	6,272	144	5,456	384	12,958	73	1,303
200 & Over	151	122	33,188	149	7,307	131	8,151	43	9,552	118	43,575	17	701
Total	28,675	25,359	872,375	20,830	73,873	8,142	34,478	4,919	46,559	5,118	86,733	3,277	31,495

Table 4.2A ALL ITEMIZER RETURNS: Continued

AGI Class* (000)	NetRents, Royalties, Partnership, etc., and Farm Income No. of Returns (14)	Amount (15)	Social Security Benefits in AGI No. of Returns (16)	Amount (17)	Other Gross Income No. of Returns (18)	Amount (19)	Total Gross Income No. of Returns (20)	Amount (21)	Moving Expense No. of Returns (22)	Amount (23)	Employee Business Expense No. of Returns (24)	Amount (25)	Two-Earner Deduction No. of Returns (26)	Amount (27)
(Number of Returns in 000, Amounts in $ millions)														
1983 Law														
Under 10	707	(6,860)			560	334	2,542	15,660	37	36	96	197	100	45
10 - 15	621	(740)			999	588	2,977	40,194	109	244	309	913	278	137
15 - 20	695	(839)			1,397	1,267	3,872	71,221	97	161	482	1,019	651	467
20 - 30	1,647	(883)			3,915	4,283	9,330	246,426	233	610	1,273	2,376	2,938	2,895
30 - 50	2,549	(1,297)			5,506	4,773	12,338	492,039	257	894	1,917	3,904	5,780	7,290
50 - 100	1,514	2,557			1,655	2,751	3,975	261,066	114	582	727	1,913	1,591	2,340
100 - 200	422	4,302			239	1,057	590	80,631	23	179	95	504	123	211
200 & Over	132	6,829			72	910	155	85,278	3	29	18	149	25	53
Total	8,287	3,069			14,342	15,963	35,778	1,292,515	872	2,736	4,917	10,975	11,486	13,439
1988 Law														
Under 10	637	(10,212)	0	0	1,039	(7,998)	1,788	1,024						
10 - 15	498	(392)	4	1	1,662	416	2,376	34,114						
15 - 20	513	(679)	64	74	2,065	708	2,707	52,255						
20 - 30	1,275	(185)	648	1,116	6,015	4,934	7,096	194,263						
30 - 50	2,059	(179)	950	2,075	9,300	7,037	10,317	425,507						
50 - 100	1,377	4,639	456	1,211	3,542	4,838	3,663	257,109						
100 - 200	412	7,145	97	329	566	2,265	577	91,096						
200 & Over	129	10,077	30	111	150	1,952	151	114,501						
Total	6,900	10,213	2,247	4,918	24,338	14,152	28,675	1,169,868						

Table 4.2A ALL ITEMIZER RETURNS: Continued

			Other		Total		Adjusted Gross		Itemized Deductions					
	IRA's		Adjustments		Adjustments		Income (AGI)		Medical & Dental		S & L Income Taxes		Real Estate Taxes	
AGI Class* (000)	No. of Returns (28)	Amount (29)	No. of Returns (30)	Amount (31)	No. of Returns (32)	Amount (33)	No. of Returns (34)	Amount (35)	No. of Returns (36)	Amount (37)	No. of Returns (38)	Amount (39)	No. of Returns (40)	Amount (41)
						(Number of Returns in 000, Amounts in $ millions)								
							1983 Law							
Under 10	133	184	261	521	438	983	2,542	14,676	1,473	4,868	1,555	453	1,404	1,137
10 - 15	271	547	549	673	1,014	2,514	2,977	37,680	1,701	4,243	2,487	1,310	2,088	1,734
15 - 20	523	1,151	630	377	1,497	3,174	3,872	68,046	1,901	2,856	3,365	2,596	2,889	2,196
20 - 30	1,834	4,223	1,657	941	4,959	11,046	9,330	235,381	3,276	5,265	7,917	10,088	7,042	5,985
30 - 50	4,106	10,241	2,548	1,940	8,716	24,249	12,338	467,790	2,691	4,385	10,243	20,892	10,493	10,918
50 - 100	2,325	5,864	1,115	2,082	3,151	12,782	3,975	248,284	568	1,374	3,130	11,688	3,603	5,678
100 - 200	345	908	183	967	440	2,760	590	77,871	36	328	441	3,705	533	1,433
200 & Over	102	249	43	407	120	886	155	84,392	4	132	98	2,849	142	621
Total	9,638	23,367	6,986	7,908	20,336	58,394	35.778	1,234,121	11,649	23,452	29,237	53,581	28,195	29,702
							1988 Law							
Under 10	70	82	267	382	314	465	1,788	677	1,147	4,151	1,189	380	1,074	907
10 - 15	114	196	534	355	625	551	2,376	33,726	1,064	3,347	2,013	1,090	1,769	1,476
15 - 20	180	358	586	361	720	719	2,707	51,694	1,076	1,716	2,330	1,932	2,269	1,785
20 - 30	719	1,376	1,468	887	2,036	2,262	7,096	192,338	1,576	3,208	6,022	8,037	5,791	5,286
30 - 50	1,254	1,617	2,302	1,653	3,273	3,270	10,317	422,723	1,052	2,421	8,656	18,605	9,201	10,050
50 - 100	313	357	1,049	1,935	1,274	2,292	3,663	255,048	171	764	2,924	11,332	3,376	5,463
100 - 200	39	53	180	944	208	997	577	90,158	18	229	437	3,694	524	1,420
200 & Over	9	14	42	403	48	416	151	114,103	2	96	97	2,848	139	617
Total	2,697	4,054	6,428	6,920	8,497	10,974	28,675	1,160,467	6,107	15,931	23,668	47,916	24,142	27,002

Table 4.2A ALL ITEMIZER RETURNS: Continued

AGI Class* (000)	Itemizied Deductions - Continued											ZBA Amount (53)	Amount of Excess Itemized Deductions (54)	Total No. of Exemp- tions (55)	Value of Exemp- tions (56)
	Sales Tax		Other Taxes		Interest		Contributions		Miscellaneous						
	No. of Returns (42)	Amount (43)	No. of Returns (44)	Amount (45)	No. of Returns (46)	Amount (47)	No. of Returns (48)	Amount (49)	No. of Returns (50)	Amount (51)	Total Amount (52)				
(Number of Returns in 000, Amounts in $ millions)															
1983 Law															
Under 10	2,092	432	746	90	1,661	4,930	1,581	962	1,461	706	13,578	5,607	7,968	5,192	5,192
10 - 15	2,705	709	1,207	130	2,582	7,894	2,323	1,936	2,329	1,357	19,313	8,098	11,211	7,328	7,328
15 - 20	3,711	1,095	1,806	214	3,526	10,680	3,186	2,785	3,106	1,505	23,927	11,092	12,830	10,662	10,662
20 - 30	8,808	3,280	4,336	579	8,690	30,236	7,895	6,217	8,010	4,703	66,353	28,254	38,021	27,878	27,878
30 - 50	12,006	5,700	5,975	991	11,633	50,271	11,260	10,974	10,862	7,179	111,310	40,083	71,075	41,166	41,166
50 - 100	3,884	2,533	1,863	467	3,592	22,386	3,777	7,095	3,394	3,372	54,593	13,067	41,388	13,513	13,513
100 - 200	578	553	266	110	507	5,212	560	2,762	483	1,074	15,177	1,926	13,224	2,045	2,045
200 & Over	148	208	72	88	133	3,248	149	5,279	129	936	13,361	503	12,804	537	537
Total	33,933	14,511	16,271	2,668	32,322	134,856	30,730	38,010	29,772	20,834	317,614	108,630	208,521	108,320	108,320
1988 Law															
Under 10			574	69	1,357	3,534	1,073	733	738	3,140	12,914			3,639	5,530
10 - 15			953	101	2,069	5,934	1,767	1,544	931	2,526	16,018			5,526	8,844
15 - 20			1,298	143	2,477	7,869	2,281	2,204	969	2,057	17,706			7,315	11,786
20 - 30			3,355	451	6,653	23,393	6,252	5,204	2,460	5,167	50,746			21,183	34,237
30 - 50			5,038	814	9,817	39,937	9,745	9,961	2,938	6,733	88,521			33,764	54,753
50 - 100			1,762	440	3,367	18,477	3,533	6,891	980	3,472	46,839			11,970	19,401
100 - 200			264	109	500	4,306	548	2,746	149	1,110	13,614			1,823	2,956
200 & Over			71	88	130	2,615	146	5,276	25	550	12,090			470	762
Total			13,315	2,215	26,370	106,065	25,343	34,559	9,189	24,755	258,443			85,690	138,269

Table 4.2A ALL ITEMIZER RETURNS: Continued

AGI Class* (000)	Taxable Income		Taxable Income Less ZBA		Tax Before Credits		Credits		Alternative Minimum Tax (AMT)		Earned Income Credit (EIC)		Net Income Tax Liability	
	No. of Returns (57)	Amount (58)	No. of Returns (59)	Amount (60)	No. of Returns (61)	Amount (62)	No. of Returns (63)	Amount (64)	No. of Returns (65)	Amount (66)	No. of Returns (67)	Amount (68)	No. of Returns (69)	Amount (70)
(Number of Returns in 000, Amounts in $ millions)														
1983 Law														
Under 10	1,900	7,187	1,297	4,208	1,271	391	105	23	4	64	346	84	1,500	361
10 - 15	2,719	20,429	2,476	13,369	2,486	1,884	676	177	2	8	0	0	2,418	1,729
15 - 20	3,824	44,836	3,752	33,966	3,752	5,078	1,046	331	1	13	0	0	3,610	4,787
20 - 30	9,283	169,842	9,236	141,770	9,235	23,862	3,091	897	18	640	0	0	9,153	23,059
30 - 50	12,319	355,784	12,308	315,776	12,308	62,091	4,611	1,468	58	21	0	0	12,289	60,885
50 - 100	3,962	193,602	3,960	180,578	3,959	46,830	1,827	1,156	102	7010	0	0	3,961	46,440
100 - 200	587	62,728	587	60,812	587	21,699	368	738	49	67	0	0	589	21,667
200 & Over	153	71,215	153	70,716	153	32,850	119	918	19	1,2300	0	0	154	33,201
Total	34,748	925,623	33,769	821,195	33,750	194,686	11,843	5,709	254	2,974	346	85	33,673	192,128
1988 Law														
Under 10	730	5,180			730	1,129	54	8	15	129	368	183	1,045	1,067
10 - 15	1,826	10,952			1,835	1,706	369	73	1	2	524	142	2,061	1,493
15 - 20	2,614	22,574			2,614	3,472	621	117	5	8	60	2	2,596	3,362
20 - 30	7,020	107,722			7,020	17,402	2,044	429	9	17	0	0	7,008	16,988
30 - 50	10,307	279,600			10,307	49,582	3,178	657	30	55	0	0	10,307	48,976
50 - 100	3,657	188,986			3,657	42,697	1,489	396	51	92	0	0	3,658	42,388
100 - 200	576	73,664			576	20,399	342	280	41	119	0	0	577	20,233
200 & Over	151	101,352			151	28,536	115	281	17	204	0	0	151	28,457
Total	26,879	790,030			26,889	164,923	8,212	2,242	169	626	953	326	27,401	162,965

*AGI as defined under 1983 law.

Table 4.2B JOINT ITEMIZER RETURNS: Gross Income, Adjustments, Deductions, Exemptions, Taxable Income and Taxes Under 1983 and 1988 Law (1983 Level and Distribution of Income)

		Wages & Salaries		Interest		Dividends in AGI		Business Income or Loss		Capital Gains in AGI		Pensions in AGI	
AGI Class* (000)	Number of Returns (1)	Number of Returns (2)	Amount (3)	Number of Returns (4)	Amount (5)	Number of Returns (6)	Amount (7)	Number of Returns (8)	Amount (9)	Number of Returns (10)	Amount (11)	Number of Returns (12)	Amount (13)
					(Number of Returns in 000, Amounts in $ millions)								
						1983 Law							
Under 10	877	527	6,117	678	1,595	119	576	333	724	203	611	240	978
10 - 15	1,253	973	10,893	873	2,479	191	353	405	1,552	203	332	322	2,282
15 - 20	2,067	1,715	29,927	1,285	3,152	256	592	519	2,328	287	505	356	2,842
20 - 30	6,296	5,875	149,713	4,135	6,864	537	1,227	1,185	5,876	743	1,042	501	3,928
30 - 50	10,682	10,164	380,606	8,144	18,585	1,630	3,978	1,533	11,453	1,602	2,638	1,022	10,824
50 - 100	3,571	3,278	182,546	3,196	17,791	1,410	6,769	686	12,468	1,295	4,987	407	6,281
100 - 200	518	435	43,962	505	7,335	352	4,856	137	5,414	340	3,955	60	1,076
200 & Over	135	114	30,710	133	6,161	110	6,622	39	8,478	105	14,902	15	534
Total	25,400	23,081	834,474	18,948	63,963	4,604	24,973	4,838	48,292	4,779	28,972	2,922	28,745
						1988 Law							
Under 10	802	518	6,799	562	1,478	157	440	322	(1,360)	124	2,273	151	678
10 - 15	1,063	861	10,231	685	1,946	225	363	352	1,286	174	567	235	1,613
15 - 20	1,629	1,390	24,925	1,000	2,085	277	554	419	1,908	214	1,119	233	2,113
20 - 30	4,966	4,705	120,587	3,281	4,447	859	889	985	4,951	563	2,583	350	2,645
30 - 50	8,952	8,598	326,153	6,783	13,446	2,430	3,398	1,302	9,745	1,300	5,405	770	8,238
50 - 100	3,304	3,066	172,508	2,953	15,261	1,698	6,385	637	11,599	1,188	11,856	348	5,517
100 - 200	508	430	43,754	495	6,970	387	4,763	131	4,965	334	9,818	59	1,058
200 & Over	132	112	30,341	130	6,055	115	6,551	38	8,357	103	36,402	15	539
Total	21,357	19,680	735,299	15,890	51,690	6,148	23,344	4,186	41,453	3,999	70,021	2,160	22,400

Table 4.2B JOINT ITEMIZER RETURNS: Continued

AGI Class* (000)	NetRents, Royalties, Partnership, etc., and Farm Income		Social Security Benefits in AGI		Other Gross Income		Total Gross Income		Moving Expense		Employee Business Expense		Two-Earner Deduction	
	No. of Returns (14)	Amount (15)	No. of Returns (16)	Amount (17)	No. of Returns (18)	Amount (19)	No. of Returns (20)	Amount (21)	No. of Returns (22)	Amount (23)	No. of Returns (24)	Amount (25)	No. of Returns (26)	Amount (27)
(Number of Returns in 000, Amounts in $ millions)														
1983 Law														
Under 10	382	(3,916)			286	7	877	6,691	14	25	66	124	100	45
10 - 15	349	(715)			472	153	1,253	17,329	64	138	127	404	278	137
15 - 20	475	(740)			805	246	2,067	38,851	40	88	317	746	651	467
20 - 30	1,248	(984)			2,868	2,396	6,296	170,062	164	423	905	1,895	2,938	2,895
30 - 50	2,153	(1,934)			5,012	4,220	10,682	430,369	231	839	1,673	3,361	5,780	7,290
50 - 100	1,327	1,716			1,552	2,302	3,571	234,859	104	549	677	1,761	1,591	2,340
100 - 200	377	3,523			215	769	518	70,889	22	179	89	455	123	211
200 & Over	115	5,437			64	808	135	73,651	3	27	17	132	25	53
Total	6,427	2,388			11,273	10,900	25,400	1,042,700	643	2,269	3,871	8,879	11,486	13,439
1988 Law														
Under 10	413	(8,346)	0	0	625	(6,774)	802	(4,809)						
10 - 15	316	(307)	2	0	887	242	1,063	15,940						
15 - 20	362	(614)	34	60	1,360	298	1,629	32,389						
20 - 30	928	(421)	343	581	4,393	2,976	4,966	138,657						
30 - 50	1,730	(759)	773	1,730	8,224	6,588	8,952	372,212						
50 - 100	1,219	3,485	359	975	3,219	4,492	3,304	231,102						
100 - 200	369	6,075	76	268	502	1,945	508	79,348						
200 & Over	113	8,327	24	90	131	1,808	132	98,378						
Total	5,449	7,440	1,611	3,704	19,341	11,574	21,357	963,215						

Table 4.2B JOINT ITEMIZER RETURNS: Continued

AGI Class* (000)	IRA's		Other Adjustments		Total Adjustments		Adjusted Gross Income (AGI)		Itemized Deductions Medical & Dental		S & L Income Taxes		Real Estate Taxes	
	No. of Returns (28)	Amount (29)	No. of Returns (30)	Amount (31)	No. of Returns (32)	Amount (33)	No. of Returns (34)	Amount (35)	No. of Returns (36)	Amount (37)	No. of Returns (38)	Amount (39)	No. of Returns (40)	Amount (41)
	(Number of Returns in 000, Amounts in $ millions)													
	1983 Law													
Under 10	93	134	159	404	289	732	877	5,958	748	1,671	540	180	757	770
10 - 15	164	366	259	377	634	1,421	1,253	15,908	899	1,882	1,037	593	1,085	1,021
15 - 20	340	880	394	167	1,045	2,348	2,067	36,503	1,275	2,167	1,761	1,275	1,776	1,377
20 - 30	1,477	3,656	1,160	611	4,140	9,481	6,296	160,581	2,555	3,606	5,367	6,666	5,371	4,621
30 - 50	3,868	9,855	2,172	1,479	8,156	22,805	10,682	407,564	2,463	3,811	8,775	17,507	9,437	9,812
50 - 100	2,238	5,725	1,012	1,731	2,981	12,107	3,571	222,752	528	990	2,823	10,451	3,298	5,234
100 - 200	334	890	165	803	415	2,529	518	68,360	31	202	387	3,229	480	1,309
200 & Over	98	242	38	320	112	773	135	72,878	2	56	86	2,405	127	553
Total	8,613	21,747	5,356	5,892	17,773	52,195	25,400	990,505	8,501	14,385	20,777	42,306	22,330	24,698
	1988 Law													
Under 10	41	52	137	145	169	198	802	(4,943)	603	1,262	486	153	611	620
10 - 15	85	150	226	147	295	297	1,063	15,723	618	1,368	899	534	927	881
15 - 20	148	310	384	183	490	492	1,629	32,013	798	1,387	1,374	1,053	1,450	1,147
20 - 30	634	1,249	1,047	601	1,553	1,850	4,966	137,076	1,192	1,952	4,228	5,413	4,408	4,056
30 - 50	1,214	1,555	1,959	1,247	2,898	2,802	8,952	369,826	955	2,006	7,456	15,579	8,231	8,981
50 - 100	305	343	951	1,607	1,169	1,951	3,304	229,362	147	434	2,647	10,123	3,102	5,043
100 - 200	36	49	163	781	188	830	508	78,573	15	121	384	3,221	472	1,297
200 & Over	8	13	37	315	43	328	132	98,066	1	35	86	2,404	124	549
Total	2,470	3,721	4,903	5,026	6,804	8,747	357	955,696	4,329	8,565	17,559	38,478	19,326	22,575

Table 4.2B JOINT ITEMIZER RETURNS: Continued

	Itemizied Deductions - Continued														
	Sales Tax		Other Taxes		Interest		Contributions		Miscellaneous						
AGI Class* (000)	No. of Returns (42)	Amount (43)	No. of Returns (44)	Amount (45)	No. of Returns (46)	Amount (47)	No. of Returns (48)	Amount (49)	No. of Returns (50)	Amount (51)	Total Amount (52)	ZBA Amount (53)	Amount of Excess Itemized Deductions (54)	Total No. of Exemp- tions (55)	Value of Exemp- tions (56)
	(Number of Returns in 000, Amounts in $ millions)														
	1983 Law														
Under 10	803	199	371	48	809	3,024	736	471	553	209	6,572	2,981	3,432	2,807	2,807
10 - 15	1,191	307	614	74	1,113	4,151	1,155	1,039	985	437	9,504	4,261	4,346	4,296	4,296
15 - 20	1,962	582	1,076	140	1,926	6,962	1,789	1,776	1,658	796	15,075	7,029	6,324	7,495	7,495
20 - 30	5,991	2,305	2,980	424	6,013	23,475	5,647	4,655	5,353	2,974	48,726	21,407	26,031	22,937	22,937
30 - 50	10,387	5,018	5,253	882	10,248	45,393	9,896	9,713	9,453	5,934	98,070	36,319	50,043	38,478	38,478
50 - 100	3,493	2,307	1,676	415	3,297	20,697	3,426	6,357	3,053	2,839	49,290	12,143	35,934	12,828	12,828
100 - 200	509	502	237	94	455	4,735	498	2,400	424	845	13,316	1,762	16,020	1,922	1,922
200 & Over	130	186	64	72	119	2,877	131	4,450	113	763	11,362	458	17,459	500	500
Total	24,466	11,406	12,271	2,148	23,980	111,314	23,277	30,861	21,592	14,797	251,915	86,360	159,589	91,264	91,264
	1988 Law														
Under 10			311	40	707	2,262	566	384	298	1,958	6,679			2,508	4,064
10 - 15			514	58	961	3,328	928	837	465	1,034	8,040			3,435	5,572
15 - 20			853	100	1,544	5,318	1,387	1,441	632	1,406	11,852			5,690	9,229
20 - 30			2,393	336	4,807	18,453	4,499	3,873	1,646	3,677	37,760			17,970	29,134
30 - 50			4,447	732	8,669	35,990	8,550	8,771	2,491	5,562	77,621			31,793	51,568
50 - 100			1,587	399	3,096	16,981	3,214	6,161	856	3,032	42,173			11,444	18,562
100 - 200			236	94	450	3,887	487	2,385	131	926	11,931			1,730	2,806
200 & Over			64	71	117	2,294	128	4,446	21	451	10,250			442	718
Total			10,404	1,829	20,350	88,511	19,758	28,297	6,540	18,046	206,301			75,013	121,653

Table 4.2B JOINT ITEMIZER RETURNS: Continued

Class* (000)	Taxable Income		Taxable Income Less ZBA		Tax Before Credits		Credits		Alternative Minimum Tax (AMT)		Earned Income Credit (EIC)		Net Income Tax Liability	
	No. of Returns (57)	Amount (58)	No. of Returns (59)	Amount (60)	No. of Returns (61)	Amount (62)	No. of Returns (63)	Amount (64)	No. of Returns (65)	Amount (66)	No. of Returns (67)	Amount (68)	No. of Returns (69)	Amount (70)
(Number of Returns in 000, Amounts in $ millions)														
1983 Law														
Under 10	513	1,463	178	256	178	30	24	8	2	43	211	50	364	21
10 - 15	1,143	6,881	942	3,283	946	431	230	52	0	5	0	0	893	392
15 - 20	2,035	21,141	1,964	14,298	1,964	1,920	676	243	1	9	0	0	1,840	1,709
20 - 30	6,267	110,527	6,231	89,259	6,230	13,836	2,386	738	13	43	0	0	6,150	13,169
30 - 50	10,669	307,661	10,658	271,405	10,659	51,854	4,176	1,369	34	152	0	0	10,640	50,683
50 - 100	3,561	173,069	3,560	160,962	3,560	40,917	1,675	1,059	85	587	0	0	3,561	40,503
100 - 200	516	55,007	516	53,252	516	18,823	334	674	37	481	0	0	518	18,656
200 & Over	134	61,665	133	61,210	133	28,335	106	789	16	1,026	0	0	135	28,606
Total	24,838	737,413	24,182	653,925	24,186	156,145	9,607	4,933	187	2,345	211	50	24,100	153,739
1988 Law														
Under 10	161	1,456			161	320	14	2	8	50	324	155	451	213
10 - 15	716	3,311			719	541	150	16	1	2	326	83	920	444
15 - 20	1,560	11,185			1,560	1,710	459	96	4	5	48	1	1,537	1,617
20 - 30	4,911	70,410			4,911	10,718	1,620	338	8	16	0	0	4,899	10,397
30 - 50	8,945	240,769			8,946	41,255	2,878	627	19	47	0	0	8,945	40,671
50 - 100	3,300	168,774			3,300	37,458	1,364	370	43	78	0	0	3,301	37,162
100 - 200	507	63,897			507	17,654	310	259	34	100	0	0	508	17,492
200 & Over	132	87,190			132	24,562	102	238	14	162	0	0	132	24,485
Total	20,232	646,994			20,236	134,218	6,899	1,947	130	460	698	240	20,693	132,481

*AGI as defined under 1983 law.

although the tabulations assume static behavior, the revenue estimates made by the Treasury and the JCT do assume behavioral changes.[3] Thus, for example, in making revenue estimates the level of capital gains realizations in 1988 is assumed to be substantially lower than it would have been under pre-TRA law, but the tabulations show capital gains at their (static) pre-TRA level.

Note that the total number of filers changes between 1983 law and 1988 law. The difference represents the number of taxpayers who are taxable or eligible for an earned income credit refund under 1988 law who were not taxable (or eligible for a refund) under 1983 law. For these tables, all filers under 1983 law were considered to be filers under 1988 law. The change in the number of filers affects the values of all variables, even those unaffected by the TRA or affected only through behavior.

Finally, it should be noted that the difference in taxes between 1983 and 1988 law reflects not only the TRA, but also intervening tax law changes.

Table 4.3 provides a correspondence between the columns in Tables 4.1A, 4.1B, 4.2A, and 4.2B, and the 1983 Form 1040 and Schedule A (Form 1040), copies of which appear in the SOI publication. The number of returns count associated with amounts indicates the number of returns filed with a nonzero entry on the corresponding amount line.

Note that Table 4.1A shows an increase between 1983 law and 1988 law in the number of returns showing "Net income tax liability" (column 54). The increase in total is 2.5 million returns, with most of that increase (1.8 million returns) in the under $10,000 AGI class, and most of the rest (.4 million returns) in the $10,000 to $15,000 AGI class. There are two main reasons for this increase. First, the count of returns with net income tax liability includes those returns that are filed in order to claim an earned income credit refund, i.e., returns with a negative income tax liability. The number of such returns increased by 3.5 million between 1983 and 1988 laws. Second, the TRA no longer allows dependents of another taxpayer to claim an exemption for themselves. Some 2.2 million dependents, all with AGI's below $15,000, that were not taxable under 1983 law are taxable under 1988 law. These dependents are included in the Table 4.1A counts of taxable returns and returns with net income tax liability under 1988 law.

B. 1983 Economic Income of Families

Table 4.4 shows the relationship between tax return income sources and economic income as well as some basic tax variables, classified by the economic income of families.[4] The first set of columns (1-33) in Table 4.4 corresponds directly to columns 1-15 and 17-35 in Table 4.1A, and the last set of columns (91-107) corresponds directly to columns 36, 38-43 and 46-55 in Table 4.1A except that the units are families in Table 4.4 (returns in Table 4.1A), and the income classifier is economic income (AGI in Table 4.1A). Therefore, total amounts, but not the number of units or amounts by income

Table 4.3 Correspondence between Tables 4.1A, 4.1B, 4.2A, 4.2B, and 1983 Form 1040

Table 4.1A,B Column	Table 4.2A,B Column	Form 1040 Line	Comment
1	1	N/A	Count of all returns filed, including returns filed only to obtain a refund of overwithholding or the earned income credit.
3	3	7	Wages and salaries.
5	5	8	Interest.
7	7	9c	Dividends in AGI (i.e., after exclusion under 1983 law, total dividends under 1988 law since exclusion repealed by TRA).
9	9	12	Business income or loss.
11	11	13 & 14	Capital gains in AGI (i.e., after exclusion under 1983 law, total capital gains under 1988 law since exclusion repealed by TRA).
13	13	16 & 17b	Pensions in AGI (under 1988 law, reflects TRA repeal of 3-year rule, a timing adjustment).
15	15	18 & 19	Net rents, royalties, partnerships, etc., and farm income (under 1988 law, reflects phase-in of passive loss rules).
17	17	N/A	Social Security benefits in AGI (1988 law only, since inclusion of a portion of Social Security benefits in AGI was not effective until 1984).
19	19	10, 11, 15, 20b, & 21	Other gross income (under 1988 law, reflects TRA disallowance of 20 percent of business meal expenses, lower cap on 401(k)s, and disallowance of certain deferred annuity contracts).
21	21	22	Gross income.
23	23	23	Moving expense (1983 law only; TRA made into an itemized deduction—see "Miscellaneous itemized deductions").
25	25	24	Employee business expenses (1983 law only; TRA made into an itemized deduction—see "Miscellaneous itemized deductions").
27	27	29	Two-earner deduction (1983 law only; repealed by TRA).
29	29	25a	IRA deduction (under 1988 law, reflects TRA phaseout by AGI of deductible IRAs for taxpayers covered by pensions).
31	31	26, 27, 28, & 30	Other adjustments (1988 law does not include disability income exclusion, which was repealed effective in 1984).
33	33	31	Total adjustments.
35	35	32 & 33	Adjusted gross income (AGI).
36	-	N/A	Count of nonitemizers (increases substantially between 1983 and 1988 law, primarily due to the increase in the standard deduction and the repeal or restrictions on certain itemized deductions under TRA).
37	-	N/A	Amount of standard deduction including additional standard deduction for the blind and elderly (1988 law only; replaced zero bracket amount, but subtracted from AGI in arriving at taxable income, rather than being built into rate schedule as was the ZBA).

Table 4.3 (continued)

38	1	N/A	Count of itemizers.
-	37	7, Sch. A	Medical and dental expenses (under 1988 law, reflects TRA increase in floor from 5 percent of AGI to 7.5 percent of AGI).
-	39	8, Sch. A	State and local income taxes.
-	41	9, Sch. A	Real estate taxes.
-	43	10a&b, Sch.A	Sales taxes (1983 law only; repealed by TRA).
-	45	11, Sch. A	Other taxes.
-	47	16, Sch. A	Interest expense (under 1988 law, reflects phaseout of deduction for consumer and excess investment interest).
-	49	20, Sch. A	Contributions.
-	51	21&25, Sch.A	Miscellaneous itemized deductions (under 1988 law, includes combination of "miscellaneous" deductions and employee business expenses, and imposition of 2 percent of AGI floor on this combined amount under TRA; also includes moving expenses under 1988 law, and casualty and theft losses under both 1983 and 1988 laws).
-	52	26, Sch. A	Total itemized deductions.
-	53	27, Sch. A	Zero bracket amount (ZBA), including unused ZBA (1983 law only; TRA replaced with standard deduction).
39	54	28, Sch. A	Excess itemized deductions.
40	55	6e	Total number of exemptions (under 1988 law, reflects TRA repeal of allowance of exemption on the return of a dependent of another taxpayer, and repeal of the extra exemption for aged and blind taxpayers).
41	56	36	Value of exemptions ($1,000/ exemption under 1983 law; $1,950/ exemption under 1988 law).
43	58	37	Taxable income [Note: always ≥ 0].
45	60	N/A	Taxable income less ZBA (computed; 1983 law only) [Note: added for comparison with 1988 law, for which the standard deduction is subtracted in arriving at taxable income; always ≥ 0].
47	62	40	Tax before credits (under 1983 law, reflects tax savings due to income averaging; under 1988 law, reflects TRA two-bracket rate schedule, plus phaseouts of 15 percent bracket and of exemptions).
49	64	48	Credits (under 1988 law, reflects repeal of the investment tax credit and political contributions credit; also reflects expiration of energy credits under pre-TRA law).
51	66	51	Alternative minimum tax (AMT) (under 1988 law, reflects tightening of provisions, but also removal of capital gains preference and the estimated carryover AMT credit on passive losses from 1987).
53	68	59	Earned income credit (EIC) (under 1988 law, reflects higher credit rate as well as higher phaseout range).
55	70	N/A	Net income tax liability (computed as tax before credits-credits + AMT-EIC).

Table 4.4 Tax Return Income, Additional Items in Economic Income, and Tax Items for Families in 1983 (1983 Tax Law, 1983 Level and Distribution of Income)

(Number of Families in 000, Amounts in $ millions)

Economic Income Class* (000)	Number of Families (1)	Wages & Salaries		Interest		Dividends in AGI		Business Income or Loss		Capital Gains in AGI		Pensions in AGI	
		Number of Families (2)	Amount (3)	Number of Families (4)	Amount (5)	Number of Families (6)	Amount (7)	Number of Families (8)	Amount (9)	Number of Families (10)	Amount (11)	Number of Families (12)	Amount (13)
Under 10	14,531	5,628	24,678	2,841	6,510	371	721	784	(3,269)	484	2,521	1,057	7,989
10 - 15	12,067	7,625	62,478	4,006	11,387	666	693	940	2,102	534	933	1,424	8,982
15 - 20	11,177	8,329	98,678	4,373	12,178	734	1,202	994	2,779	594	946	1,215	7,675
20 - 30	18,498	15,211	269,529	8,934	23,357	1,573	3,250	1,932	6,335	1,423	2,208	1,922	12,926
30 - 50	21,745	19,426	559,272	13,752	36,823	2,730	6,319	2,709	12,183	2,431	4,470	2,095	15,383
50 - 100	11,653	10,609	478,760	9,421	38,842	3,457	12,975	1,869	19,604	2,733	7,144	1,293	12,965
100 - 200	1,326	1,103	81,758	1,263	13,498	869	9,316	384	11,839	765	5,740	197	2,862
200 & Over	364	295	56,593	358	11,207	298	12,728	122	13,703	270	20,413	41	1,033
Total	91,361	68,227	1,631,746	44,948	153,802	10,697	47,205	9,735	65,275	9,233	44,375	9,244	69,814

(Number of Families in 000, Amounts in $ millions)

Economic Income Class* (000)	NetRents, Royalties, Partnership, etc., and Farm Income		Other Gross Income		Total Gross Income		Moving Expense		Employee Business Expense		Two-Earner Deduction		IRAs	
	No. of Families (14)	Amount (15)	No. of Families (16)	Amount (17)	No. of Families (18)	Amount (19)	No. of Families (20)	Amount (21)	No. of Families (22)	Amount (23)	No. of Families (24)	Amount (25)	No. of Families (26)	Amount (27)
Under 10	934	(15,902)	562	(3,836)	7,473	19,411	39	61	107	368	124	37	56	69
10 - 15	946	(1,172)	787	134	9,612	85,534	118	163	287	646	407	156	294	512
15 - 20	1,118	(903)	1,319	842	9,750	123,396	178	269	504	1,083	871	450	551	1,041
20 - 30	2,244	(946)	3,701	3,318	17,025	319,973	348	563	1,349	2,821	3,137	2,289	1,832	3,839
30 - 50	3,696	(1,339)	6,999	5,585	20,804	638,689	486	1,124	2,576	4,760	7,456	7,791	4,806	11,316
50 - 100	3,239	1,346	4,664	4,162	11,389	575,793	314	1,112	1,745	3,992	5,174	6,905	5,026	12,687
100 - 200	819	3,226	534	892	1,319	129,131	38	289	224	1,020	426	688	788	2,035
200 & Over	302	2,549	165	(627)	364	117,597	9	89	46	342	70	130	220	562
Total	13,297	(13,141)	18,729	10,470	77,734	2,009,525	1,531	3,671	6,839	15,033	17,666	18,445	13,572	32,059

Table 4.4 Economic Income of Families - continued

Economic Income Class* (000)	Other Adjustments		Total Adjustments		Adjusted Gross Income (AGI)		Adjustments to AGI Under 1983 Law		Amount of Unreported Income	Total Social Security and RR Retirement		Addendum: Nontaxed SS & RR Under 1988 Tax Law	
	No. of Families (28)	Amount (29)	No. of Families (30)	Amount (31)	No. of Families (32)	Amount (33)	No. of Families (34)	Amount (35)	(36)	No. of Families (37)	Amount (38)	No. of Families (39)	Amount (40)
	(Number of Families in 000, Amounts in $ millions)												
Under 10	301	567	486	1,103	7,473	18,309	873	621	20,127	7,107	31,861	7,101	31,686
10 - 15	623	646	1,285	2,124	9,612	83,410	1,749	1,245	18,196	4,717	28,791	4,715	28,200
15 - 20	820	706	2,103	3,549	9,750	119,847	2,466	2,137	21,889	3,691	23,985	3,689	23,190
20 - 30	1,988	1,505	6,096	11,013	17,025	308,961	6,713	7,329	43,189	5,280	34,291	5,279	32,328
30 - 50	3,487	2,093	11,957	27,081	20,804	611,610	12,893	20,646	62,100	4,985	33,652	4,982	28,150
50 - 100	2,569	2,872	8,439	27,548	11,389	548,247	9,280	21,985	51,212	2,589	17,129	2,588	11,992
100 - 200	448	1,884	1,041	5,909	1,319	123,223	1,229	4,252	14,657	332	2,314	332	1,360
200 & Over	116	1,237	278	2,342	364	115,254	352	1,611	20,535	82	577	82	304
Total	10,353	11,512	31,684	80,668	77,734	1,928,862	35,554	59,827	251,903	28,782	172,601	28,768	157,210

Economic Income Class* (000)	Unemployment Compensation		Workmen's Compensation		Veterans' Benefits		Food Stamps		Welfare Benefits		Pension and Profit Sharing Plans		Health and Medical Insurance	
	No. of Families (41)	Amount (42)	No. of Families (43)	Amount (44)	No. of Families (45)	Amount (46)	No. of Families (47)	Amount (48)	No. of Families (49)	Amount (50)	No. of Families (51)	Amount (52)	No. of Families (53)	Amount (54)
	(Number of Families in 000, Amounts in $ millions)													
Under 10	906	1,331	297	553	612	1,209	3,437	3,516	2,820	6,863	2,211	749	2,282	1,758
10 - 15	1,537	3,024	423	920	459	1,207	2,838	3,201	1,698	4,879	3,712	2,083	4,072	3,996
15 - 20	1,587	3,666	513	1,071	479	1,576	1,962	2,221	1,215	3,526	4,759	3,826	5,201	5,848
20 - 30	1,983	5,107	1,044	2,779	847	3,124	1,786	2,029	1,262	3,974	10,421	13,040	11,293	14,347
30 - 50	1,218	2,776	1,454	4,181	925	3,685	738	1,037	682	2,396	16,208	33,491	16,842	27,480
50 - 100	617	1,354	732	2,204	471	1,658	133	249	174	677	9,825	33,498	9,838	20,636
100 - 200	55	133	41	120	43	255	7	13	4	19	1,019	6,056	1,006	2,282
200 & Over	5	8	14	39	4	18	0	0	0	0	274	4,377	266	613
Total	7,907	17,399	4,518	11,868	3,839	12,731	10,900	12,266	7,856	22,333	48,428	97,120	50,800	76,960

Table 4.4 Economic Income of Families - continued

Economic Income Class* (000)	Military Benefits and Fringe Benefits		Other Untaxed Employer Contributions		Less: Taxable Pensions		Earnings on Pension Funds		Earnings on Life Insurance, IRA's and Keogh's		Real Pre-Tax Corporate Economic Income		Less: Dividends before Exclusion	
	No. of Families (55)	Amount (56)	No. of Families (57)	Amount (58)	No. of Families (59)	Amount (60)	No. of Families (61)	Amount (62)	No. of Families (63)	Amount (64)	No. of Families (65)	Amount (66)	No. of Families (67)	Amount (68)
	(Number of Families in 000, Amounts in $ millions)													
Under 10	2,134	467	2,959	78	2,215	(10,476)	2,478	791	2,027	213	6,066	3,269	806	(848)
10 - 15	2,916	1,278	5,007	250	1,986	(10,233)	4,126	2,757	3,300	469	7,340	5,111	1,048	(882)
15 - 20	3,325	1,866	6,195	440	1,539	(8,663)	5,177	4,320	4,054	803	8,057	8,411	1,131	(1,364)
20 - 30	6,321	4,211	12,849	1,377	2,331	(14,130)	11,102	13,032	8,798	2,432	15,385	23,807	2,457	(3,595)
30 - 50	9,237	7,035	18,288	3,358	2,485	(16,390)	16,801	27,732	13,721	6,769	20,394	52,013	4,483	(6,900)
50 - 100	5,670	5,423	10,328	3,204	1,478	(13,693)	10,124	31,261	9,376	8,274	11,442	71,310	4,698	(13,719)
100 - 200	644	942	1,055	473	209	(2,875)	1,057	6,147	1,209	2,667	1,319	28,408	969	(9,492)
200 & Over	174	684	282	183	44	(1,036)	281	3,390	325	1,195	361	31,288	316	(12,788)
Total	30,421	21,908	56,963	9,364	12,287	(77,496)	51,146	89,430	42,809	22,822	70,365	223,617	15,908	(49,587)

Economic Income Class* (000)	Less: Dividends of Pension & Insurance Funds		Less: Capital Gains in AGI		Real Net Capital Gains Except Securities		Inflation Adjust. for Interest Received		Inflation Adjust. for All Other Income		Excess Tax Depreciation		Tax Exempt Interest	
	No. of Families (69)	Amount (70)	No. of Families (71)	Amount (72)	No. of Families (73)	Amount (74)	No. of Families (75)	Amount (76)	No. of Families (77)	Amount (78)	No. of Families (79)	Amount (80)	No. of Families (81)	Amount (82)
	(Number of Families in 000, Amounts in $ millions)													
Under 10	4,007	(175)	484	(2,521)	462	165	5,826	(2,762)	1,287	1,948	1,152	1,275	6	35
10 - 15	6,092	(595)	534	(933)	476	(71)	8,020	(5,160)	1,106	616	1,234	478	16	27
15 - 20	7,052	(932)	594	(946)	534	230	8,582	(5,897)	1,205	723	1,381	550	21	19
20 - 30	14,021	(2,809)	1,423	(2,208)	1,285	388	15,950	(12,639)	2,333	1,588	2,687	1,190	114	111
30 - 50	19,188	(6,004)	2,431	(4,470)	2,196	1,152	20,493	(22,214)	3,804	2,777	4,433	1,946	290	456
50 - 100	11,080	(6,782)	2,733	(7,144)	2,545	2,949	11,416	(24,348)	3,393	3,287	3,642	2,366	444	1,374
100 - 200	1,254	(1,362)	765	(5,740)	712	2,141	1,315	(8,003)	922	2,056	876	1,472	299	3,056
200 & Over	337	(750)	270	(20,413)	261	14,712	364	(6,989)	317	2,975	307	2,103	178	5,927
Total	63,032	(19,410)	9,233	(44,375)	8,470	21,665	71,966	(88,012)	14,365	15,972	15,713	11,381	1,367	11,005

Table 4.4 Economic Income of Families - continued

Economic Income Class* (000)	Real Net Rental Value of Owner Occupied Housing		Other Economic Income		Total Adjust. from 1983 Law AGI to Economic Income		Economic Income of Families		No. of Non-Itemizrs (91)	No. of Itemizrs (92)	Amount of Excess Itemized Deductions (93)	Total No. of Exemptions (94)	Value of Exemptions (95)
	No. of Families (83)	Amount (84)	No. of Families (85)	Amount (86)	No. of Families (87)	Amount (88)	No. of Families (89)	Amount (90)					
(Number of Families in 000, Amounts in $ millions)													
Under 10	5,724	4,512	54	3,390	14,469	67,949	14,530	86,257	13,819	713	3,630	14,203	14,203
10 - 15	6,221	7,693	34	444	12,055	68,793	12,067	152,203	10,633	1,435	6,026	22,486	22,486
15 - 20	6,393	7,824	25	417	11,169	77,544	11,177	197,391	8,951	2,225	8,064	25,747	25,747
20 - 30	11,278	11,780	41	877	18,486	154,615	18,498	463,575	12,229	6,269	24,918	50,505	50,505
30 - 50	15,172	9,556	98	1,743	21,745	249,998	21,745	861,603	9,019	12,727	62,650	71,403	71,403
50 - 100	9,371	9,515	109	1,928	11,653	225,804	11,653	774,044	2,566	9,087	66,350	44,910	44,910
100 - 200	1,189	2,784	66	1,332	1,326	54,107	1,326	177,329	125	1,201	19,086	5,395	5,395
200 & Over	326	1,694	70	4,478	364	54,432	364	169,684	24	341	17,796	1,447	1,447
Total	55,673	55,357	498	14,608	91,267	953,243	91,360	2,882,085	57,365	33,998	208,520	236,097	236,097

Economic Income Class* (000)	Taxable Income		Tax Before Credits		Credits		Alternative Minimum Tax (AMT)		Earned Income Credit (EIC)		Net Income Tax Liability	
	No. of Families (96)	Amount (97)	No. of Families (98)	Amount (99)	No. of Families (100)	Amount (101)	No. of Families (102)	Amount (103)	No. of Families (104)	Amount (105)	No. of Families (106)	Amount (107)
(Number of Families in 000, Amounts in $ millions)												
Under 10	5,325	22,561	3,441	1,642	348	88	11	228	1,307	407	4,343	1,383
10 - 15	8,784	58,210	7,318	5,140	817	174	6	22	2,331	655	8,259	4,336
15 - 20	9,351	87,944	8,468	9,236	1,204	368	4	17	1,297	351	8,967	8,544
20 - 30	16,715	236,079	16,114	29,356	3,047	912	12	41	863	237	16,213	28,280
30 - 50	20,658	480,334	20,469	72,609	5,862	1,834	45	244	340	99	20,445	70,967
50 - 100	11,343	439,812	11,316	85,049	4,516	2,014	105	498	65	21	11,294	83,607
100 - 200	1,306	100,049	1,304	29,145	770	1,007	72	601	2	1	1,307	28,791
200 & Over	356	99,372	356	43,133	275	1,424	43	1,733	1	0	359	43,517
Total	73,838	1,524,361	68,787	275,311	16,838	7,822	299	3,384	6,206	1,771	71,187	269,425

class will correspond for these columns. The remaining columns in Table 4.4 (34-90) show the adjustments made to AGI (of filers) to derive the economic income of families.

Two items in Table 4.4 require some clarification. "Adjustments to AGI Under 1983 Law" (column 35) are conceptually different in two respects from the "Total Adjustments" shown in column 33 of Table 4.1A. First, Table 4.4 includes only adjustments which must be added back to AGI to arrive at economic income (these adjustments are IRA and Keogh contributions, the two earner deduction, the penalty for early withdrawal of savings, and the disability income exclusion). Second, Table 4.4 includes the dividend exclusion as an adjustment. The other item requiring clarification is the "Amount of Unreported Income" (column 36). It includes all income earned by persons below tax filing thresholds, income earned by nonfilers who should be filers, and income underreported or not reported by tax filers.

FOOTNOTES

[1] For a detailed description of the data base, see James Cilke and Roy Wyscarver, *"The Treasury Individual Income Tax Simulation Model,"* Chapter 2 in this volume.

[2] This may be true even for analysts following precisely the same methodology if they are examining specific effects in states with differing marginal tax rates or differing definitions of the tax base.

[3] See Howard W. Nester, *"A Guide to Interpreting the Dynamic Elements of Revenue Estimates,"* Chapter 1 in this volume, for a discussion of the behavioral changes assumed in making Treasury's revenue estimates for the Tax Reform Act of 1986.

[4] For a detailed discussion of the concept of economic income and its relationship to other income concepts including AGI, see Susan Nelson, *"Family Economic Income and Other Income Concepts Used in Analyzing Tax Reform,"* Chapter 3 in this volume.

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5 INVESTMENT INCENTIVES UNDER THE TAX REFORM ACT OF 1986

Don Fullerton, Robert Gillette, and James Mackie

I. INTRODUCTION

The Tax Reform Act of 1986 significantly changes the taxation of income from tangible capital. It lowers the top statutory marginal corporate income tax rate from 46 percent to 34 percent. It also lowers income tax rates on interest income, noncorporate business income, and dividends. In contrast, however, tax reform eliminates the 60 percent exclusion on long term capital gains. Thus, the effective rate on capital gains is increased by tax reform. In addition, tax reform alters capital cost recovery provisions, perhaps most dramatically by repeal of the investment tax credit, and it improves the matching of income and expense in accounting for multi-period production.

These changes in capital income taxation can affect marginal investment incentives in complicated ways. Rate reduction can, for example, partially offset changes in recovery allowances. Furthermore, different assets, industries, and sectors are likely to be affected differently. In order to capture the effect of simultaneous changes in corporate rates, individual rates, and recovery allowances, we measure investment incentives using a cost of capital framework. The cost of capital provides a comprehensive, forward looking measure of marginal investment incentives. It is the pre-tax return on a marginal investment needed to earn a given net of tax return, and captures the effects of depreciation, credits, and statutory rates. In addition, the standard cost of capital model can be adapted to include the effects of accounting rules for multi-period production. Finally, costs of capital for individual assets can be weighted together to obtain measures of investment incentives for more aggregate assets (equipment vs. structures), industries,

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and sectors, as well as to obtain overall economy wide measures of investment incentives.

We find that tax reform generally reduces investment incentives. Our analysis further indicates, however. that tax reform has been successful in "leveling the playing field." Regardless of its effect on overall investment and savings incentives, tax reform reduces the disparity in the taxation of alternative assets and investors. Thus, investment choices will be more efficient. Our analysis also shows that there is no unique set of effective tax rates (or costs of capital) associated with either prior law or tax reform. Instead, magnitudes and sometimes even signs depend on parameter values and modeling choices. Under some scenarios tax reform lowers overall effective tax rates. We also find that modeling accounting rules has only a small effect on the magnitude of our results.

In this paper we do not consider the ultimate effect of tax reform on the allocation of resources. Rather, we simply measure its effect on incentives to change the allocation of capital, incentives which will eventually affect resource allocation in general. A comprehensive analysis of the effect of the capital taxation provisions of tax reform on the allocation of resources is provided in this volume by Fullerton, Henderson and Mackie (1987). They use the computable general equilibrium model developed by Fullerton and Henderson (1986) to analyze the effect of changes in capital taxation on growth, resource allocation, and welfare.

The remainder of our paper is organized as follows. Section II briefly describes the cost of capital model. Section III describes the data we use to implement our analysis. In particular, in the third section we describe a very disaggregate capital stock which allows us to consider great detail in measuring and weighting reform induced changes in the taxation of different assets. Sections IV-VII present our results, including sensitivity analyses. In Section VIII we model accounting rules. We conclude in Section IX with a summary of our findings and suggestions for future work.

II. THE MODEL OF INVESTMENT INCENTIVES

We use the model developed in Fullerton (1987) and Fullerton and Henderson (1984) to measure investment incentives. Their model abstracts from issues related to risk, and is based in turn on the neo-classical rental rate approach of Hall and Jorgenson (1967). It captures the effects of personal and corporate income taxes and property taxes at the federal, state, and local levels, as well as depreciation allowances, and credits.[1]

A. The Discount Rate, Personal Taxes, and Arbitrage

In calculating the discount rate, r, we follow Fullerton and Henderson (1984) and consider two alternative arbitrage scenarios. The first scenario is individual arbitrage, which requires that all ultimate savers earn the same after all tax return, s, on investments in all sectors (corporate, noncorporate business, and owner-occupied housing). Savers (investors) trade off between debt and other investments until the net of all tax return on all investment equals the net of all tax return on debt:

$$s = s_c = s_{nc} = s_h = i(1-\tau_d)-\pi \tag{5.1}$$

where s_c, s_{nc}, and s_h are the net returns to ultimate savers for investment in the corporate, noncorporate, and owner-occupied housing sectors, respectively, i is the nominal interest rate, τ_d is the tax rate on interest income, and π is the inflation rate.

The after all tax return to savers, s, and the inflation rate, π, are specified exogenously, and (once τ_d is specified below) equation (5.1) is used to solve for the interest rate. The discount rate for each sector can then be determined as a function of the interest rate, personal tax parameters, and financing shares.

Corporations can finance real investment by new debt, retained earnings, or new share issues. Corporate debt financed investment in real capital must earn the after-tax interest cost, i(1-u), where u is the statutory marginal tax rate on corporate income. Corporate investment financed by retentions must earn a return r such that ultimate savers are indifferent between interest payments and the capital gains such re-investment will yield: $r(1-\tau_{re})$ must equal $i(1-\tau_d)$, where τ_{re} is the personal tax on accrued capital gains. Similarly, new share issues must earn a return such that investors are indifferent between interest payments and dividends: $r(1-\tau_{ns})$ must equal $i(1-\tau_d)$ where τ_{ns} is the personal tax on dividends. The corporate nominal discount rate is a weighted average of the three discount rates:

$$c_d\left[i(1-u)\right] + c_{re}\left[\frac{i(1-\tau_d)}{(1-\tau_{re})}\right] + c_{ns}\left[\frac{i(1-\tau_d)}{(1-\tau_{ns})}\right] \tag{5.2}$$

where c_d, c_{re}, c_{ns}, are the fractions of corporate investment financed by debt, retentions, and new shares, respectively.

Similarly, noncorporate firms have an after-tax interest cost of $i(1-\tau_{nc})$, and their equity must earn $i(1-\tau_d)$ after taxes where τ_{nc} is the tax rate on noncorporate business income. Thus, the overall discount rate for the noncorporate firm is

$$n_d[i(1-\tau_{nc})]+n_e[i(1-\tau_d)] \tag{5.3}$$

where n_d, and n_e are the fractions of noncorporate investment financed by debt and equity, respectively. Identical logic gives

$$h_d[i(1-\tau_h)]+h_e[i(1-\tau_d)] \tag{5.4}$$

as the discount rate for owner-occupied housing, where h_d and h_e are the fraction of investment in owner-occupied housing financed by debt and equity, respectively and τ_h is the income tax rate at which homeowners deduct interest payments.

With individual arbitrage, ultimate investors earn the same after-tax real return on all investments. However, firms earn different returns on debt financed than on equity financed investment. As an alternative, we consider arbitrage between debt and real capital at the firm level. Under this alternative assumption, net-of-tax returns are equated for the firm, and so the firm uses the cost of debt, i(1-u), as the discount rate for all investments, regardless of the actual source of finance. In this case, however, net-of-tax returns differ for ultimate savers depending on whether the investment is in the corporate business, noncorporate business, or owner-occupied housing sector.[2] In a perfect certainty model such as this, either firm or individual arbitrage is possible, but not both at the same time. Thus, we report results for each alternative arbitrage assumption.

B. Cost of Capital and Effective Tax Rate

The neo-classical approach exploits the competitive profit maximizing condition that the marginal investment will yield a cash flow whose present value is just sufficient to cover its acquisition price. This equilibrium condition is solved for the social return on investment, gross of tax but net of economic depreciation, which equals the marginal product of capital, and is referred to as the (financial) cost of capital. For a corporate firm the cost of capital on a marginal investment of $1, ρ^c, may be written as

$$\rho^c = \{(r-\pi+\delta)/(1-u)\}(1-k-auz)+w-\delta \qquad (5.5)$$

where r is the nominal discount rate for corporate investment (as determined above), π is the constant rate of inflation, δ is the constant rate of economic depreciation, u is the statutory rate on income generated by the marginal corporate investment, k is the rate of investment tax credit, z is the present value of tax depreciation allowances on $1 of depreciable basis, a is the percentage of basis entitled to statutory depreciation, and w is the local property tax rate. The discount rate, inflation rate, and statutory corporate income tax rate are constant across assets in the corporate sector. However, the other parameters (k, z, w, and δ) vary by asset. The cost of capital for noncorporate investment may be written as in (5.5) by replacing u with τ_{nc}, the personal tax rate on noncorporate business income. and using the appropriate noncorporate discount rate.[3]

We also measure incentives for investment in owner-occupied housing. Such investment is entitled to neither an investment tax credit nor capital recovery allowances. However, the rents generated by the investment are not taxed, while property taxes are deductible. The cost of capital for investment in owner-occupied housing may be written as

$$\rho^h = r - \pi + (1 - \lambda\tau_h)w \tag{5.6}$$

where τ_h is the tax rate at which home owners deduct property taxes and λ is the fraction of property taxes deducted.

Many of our results are shown using the cost of capital. However, we also present results based on effective tax rates. The effective tax rate, t, is defined as the difference between the cost of capital (i.e. the real pre-tax return), ρ, and the required real after tax return on investment, s, as a percentage of the cost of capital: $t=(\rho-s)/\rho$. In some cases, the effective tax rate is more easily interpreted than is the cost of capital.[4] The effective tax rate shows the total proportion of capital costs attributable to taxes at both the personal and corporate levels and can be compared with statutory rates.

III. DATA AND PARAMETERS

Our analysis considers the tax treatment of many depreciable assets, plus nondepreciable land and inventories, used in the corporate and in the noncorporate sectors of each of 60 private industries, as well as structures and land in an owner-occupied housing sector. In order to compute each asset's cost of capital and effective tax rate we must specify an economic depreciation rate as well as the relevant tax parameters and financing shares. To calculate summary measures of incentives by industry and sector, as well as measures of overall economy wide investment incentives, we need a set of weights. We first describe in Part A the detailed capital stock data we use as weights for our summary measures. Part A also discusses our assumptions on economic depreciation. Next, we describe our determination of the parameters which are affected by tax reform: capital cost recovery allowances in Part B and statutory income tax rates in Part C. We conclude with an explanation of our determination of parameters which do not change as a consequence of tax reform: financing shares in Part D and property taxes in Part E.

A. Asset Definition, Capital Stock Weights, and Economic Depreciation

Earlier studies (Auerbach (1983a), Fullerton (1987), Fullerton and Henderson (1984), Gravelle (1982)) typically consider the 34 types of depreciable property shown in Table 5.1. The most detailed of these (Fullerton (1987) and Fullerton and Henderson (1984)) compute the cost of capital for each asset for both corporate and noncorporate firms, as well as for owner-occupied housing. These disaggregate costs of capital are then weighted to obtain summary measures of investment incentives in the corporate sector, the noncorporate business sector, and for the economy as a whole.[5]

Table 5.1 **Cost Recovery Periods in Fullerton (1987)**

	Prior Law Recovery Period
1. Furniture and Fixtures	5
2. Fabricated Metal Products	5
3. Engines and Turbines	5
4. Tractors	5
5. Agricultural Machinery	5
6. Construction Machinery	5
7. Mining and Oil Field Machinery	5
8. Metalworking Machinery	5
9. Special Industry Machinery	5
10. General Industrial Equipment	5
11. Office and Computing Machinery	5
12. Service Industry Machinery	5
13. Electrical Machinery	5
14. Trucks, Buses, and Trailers	5
15. Autos	3
16. Aircraft	5
17. Ships and Boats	5
18. Railroad Equipment	5
19. Instruments	5
20. Other Equipment	5
21. Industrial Buildings	19
22. Commercial Buildings	19
23. Religious Buildings	19
24. Educational Buildings	19
25. Hospital Buildings	19
26. Other Nonfarm Buildings	19
27. Railroads	15
28. Telephone and Telegraph	15
29. Electric Light and Power	15
30. Gas Facilities	10
31. Other Public Utilities	10
32. Farm Structures	19
33. Mining, Shafts and Wells	5
34. Other Nonbuilding Facilities	19

Source: Fullerton (1987)

Although these studies incorporate much disaggregation, in at least two respects they over-simplify the tax treatment of different assets. First, the 34 assets in Table 5.1 are themselves composed of more disaggregate components which may not receive uniform cost recovery allowances. Second, and relatedly, these earlier studies did not allow for the industry specific determination of cost recovery allowances. Instead, they gave each asset the same tax treatment in all industries. However, both prior law and the Tax Reform Act of 1986 are based on the Asset Depreciation Range system (ADR) which classifies some types of personal property on an industry basis. We build on earlier work by using a more disaggregate set of assets and by allowing for industry specific cost recovery allowances.

We begin our analysis with 50 types of nonresidential and 11 types of residential depreciable property used in 60 different private industries, as tracked by the Bureau of Economic Analysis (BEA). Table 5.2 lists the 50 depreciable nonresidential BEA assets. Asset number 51, residential structures, in Table 5.2 is an amalgamation of the 11 types of BEA residential rental assets. Based on unpublished BEA data, we divide investment flows in each asset in each industry into a corporate and a noncorporate component. Next, we use an algorithm developed by the Joint Committee on Taxation (JCT) and the Office of Tax Analysis (OTA) to further disaggregate investment in each of the 61 BEA assets in each sector of each industry into components based on ADR midpoint lives.[6] For example, investment in BEA asset number 20, trucks, buses, and truck trailers (whose ADR classification does not vary by industry) is disaggregated into its components: buses, with an ADR midpoint of 9 years; light general purpose trucks, with an ADR midpoint of 4 years; heavy general purpose trucks, with an ADR midpoint of 6 years; over the road tractor units, with a 4 year ADR midpoint; and trailers and trailer mounted containers with a 6 year ADR midpoint. In addition, the algorithm assigns industry specific ADR midpoints where appropriate. For example, under the ADR system, most personal property used in the mining industry has an ADR midpoint of 10 years, while if used in the construction industry the same property would have a midpoint of 6 years. The algorithm takes this into account and, for instance, assigns BEA asset number 7, construction tractors, a 10 year ADR midpoint in the coal mining industry, but a 6 year ADR midpoint in the construction industry.

After computing the cost of capital for each component of each asset in each industry based on ADR life, we wish to aggregate up so that our results are more accessible. This requires a set of weights. Two common weights are investment flows (see, for example the International Trade Commission (1986)) and capital stocks. We follow Fullerton (1987) and Fullerton and Henderson (1984) in using capital stock weights. Fundamentally, we are concerned with the size of the capital stock and its allocation across different assets and sectors. Investment is important, but primarily as the means through which changes in the stock of capital are realized. Thus, a marginal change in our analysis is a proportional expansion of the existing capital stock. Therefore

Table 5.2 Cost Recovery Parameters in the Corporate Sector

Asset	Economic Depreciation Rate	ITC ITC	Cost Recovery*	
			ACRS Recovery Period	Tax Reform Recovery Period
1. Furniture & Fixtures (Household)	.110	.100	5.00	5.20
2. Furniture & Fixtures (Other)	.110	.100	5.00	7.00
3. Fabricated Metal Products	.090	.100	5.40	6.49
4. Steam Engines and Turbines	.080	.100	10.67	15.30
5. Internal Combustion Engines	.076	.100	8.01	11.70
6. Farm Tractors	.161	.100	5.00	6.52
7. Construction Tractors	.163	.100	5.00	5.15
8. Other Agricultural Machinery	.097	.100	5.00	7.00
9. Other Construction Machinery	.170	.100	5.00	5.36
10. Mining And Oilfield Machinery	.168	.100	5.00	7.00
11. Metalworking Machinery	.123	.091	4.53	5.86
12. Special Industry Machinery	.102	.098	4.89	6.60
13. General Industrial Equipment	.122	.098	5.25	7.26
14. Office Computing Machinery	.273	.100	5.00	5.00
15. Service Industry Machinery	.166	.100	5.12	5.24
16. Communications Equipment	.115	.100	7.73	9.99
17. Elec. Trans., Dist., & Indus. Appar.	.081	.099	7.74	10.34
18. Electric Household Appliances	.118	.100	5.00	5.00
19. Other Electrical Equipment	.116	.100	5.00	5.23
20. Trucks, Buses and Truck Trailers	.253	.071	3.56	5.00
21. Autos	.333	.060	3.00	5.00
22. Aircraft	.183	.100	5.00	7.00
23. Ships and Boats	.075	.100	5.00	9.88
24. Railroad Equipment	.066	.100	5.00	7.00
25. Scientific & Engin. Instruments	.139	.100	6.32	7.78
26. Photographic Instruments	.146	.100	4.98	5.20
27. Other Nonresidential Equipment	.146	.100	5.00	5.32
28. Industrial Buildings	.036	.025	15.51	25.49
29. Mobile Commercial Offices	.080	.000	19.00	31.50
30. Commercial Office Buildings	.025	.000	19.00	31.50
31. Commercial Warehouses	.025	.000	19.00	31.50
32. Other Commercial Buildings	.026	.067	9.67	14.34
33. Religious Buildings	.019	.000	19.00	31.50
34. Educational Buildings	.019	.000	19.00	31.50
35. Hospital and Institut. Buildings	.023	.000	19.00	31.50
36. Hotels and Motels	.045	.000	19.00	31.50
37. Amusement and Recreational	.044	.100	10.00	13.47
38. Other Nonfarm Buildings	.045	.000	19.00	31.50
39. Railroads	.030	.100	5.00	7.00
40. Telephone and Telegraph	.032	.076	10.56	12.59
41. Electric Light and Power	.032	.100	13.00	18.00
42. Gas	.032	.057	12.71	20.22
43. Local Transit	.032	.100	5.00	5.00
44. Petroleum Pipelines	.032	.100	5.00	15.00
45. Farm	.024	.000	19.00	20.00
46. Oil & Gas Explor, Shafts & Wells	.056	.100	5.00	7.00
47. Other Mining Shafts and Wells	.056	.100	5.00	7.00
48. Other Nonresidential Structures	.029	.000	19.00	31.50
49. Railroad Replacement Track	.032	.100	5.00	7.00
50. Nuclear Fuel	.250	.100	5.00	5.00
51. Residential Structures	.036	.001	18.94	27.45

Source: Described in the text.

*These are averages weighted by capital stocks. They differ from statutory ITC allowances or recovery periods because each numerical asset may contain components with differing ITC allowances or recovery periods.

we compute the capital stock for each component of each asset used in the corporate and noncorporate sector of each industry.[7] Using these stocks as weights, we aggregate to the 50 types of nonresidential depreciable property plus residential rental property shown in Table 5.2. These capital stock weights are also used to compute summary measures of investment incentives by industry, by sector, as well as economy wide averages.

In addition to depreciable assets, we measure investment incentives for nondepreciable land and inventories. These are included in overall average measures using stock weights based on those used by Fullerton (1987).

We compute economic depreciation rates for each component of our disaggregate depreciable assets based on rates computed by Hulten and Wykoff (1981) and Jorgenson and Sullivan (1981). The weighted average rate is shown in Table 5.2 for each of the 51 depreciable assets used in the corporate sector.

B. Capital Cost Recovery: The Investment Tax Credit and Depreciation Allowances

Prior law provides a 6 percent investment tax credit (ITC) for autos, light trucks, and certain short lived special manufacturing equipment, and a 10 percent ITC for other types of equipment and for public utility property. Real property does not receive the ITC. Tax reform would eliminate the ITC for all investment.

It is apparent from the Hulten-Wykoff economic depreciation rates of Table 5.2 that different assets depreciate at very different rates. Tax law, however, tends to group assets into a limited number of depreciation classes, thus generating nonneutralities.[8] Prior law Accelerated Cost Recovery System (ACRS) groups assets into five classes. Recovery is based on historic cost, and recovery periods range from 3 to 19 years. Assets in classes 1-4 (personal property–equipment–and public utility property) receive recovery allowances based on 150 percent declining balance, with an optimal switch to straight line. Real property (class 5) receives 175 percent declining balance, with an optimal switch to straight line, over a 19 year recovery period. Depreciable basis is reduced by one-half of the ITC. Thus, in equation (5.5) a equals (1-.5k).

Using a JCT-OTA algorithm, we assign an ITC rate and an ACRS cost recovery period to each ADR component of each asset in each industry.[9] Table 5.2 shows the average ITC rate and the average ACRS recovery period for each of 51 depreciable assets in the corporate sector. These ITC rates and recovery periods can differ from statutory allowances because they are capital weighted averages of components with differing statutory allowances.

Table 5.1 shows the prior law ACRS classification of assets used by Fullerton (1987). Comparison with our classification in Table 5.2 highlights several differences. Among types of equipment (assets 1-27 of Table 5.2) we show some assets with a longer recovery period than Fullerton (1987). and some with a shorter recovery period. For example. our classification of engines and turbines (assets 3 and 4 in Table 5.2) gives a recovery period averaging between 8 and 11 years, longer than the 5 year period used by Fullerton (1987). We give other assets, such as metal working machinery, a shorter ACRS recovery period than in Fullerton (1987). On the whole, for equipment we differ from Fullerton (1987) more often by using a longer than a shorter recovery period. This is partly due to the fact that some components of assets 1-27 of Table 5.2 are 19 year real property under ACRS, and some components are 10 year or 15 year public utility property under ACRS.

Our classification of structures indicates somewhat shorter ACRS recovery periods than those used by Fullerton (1987). Our data indicates that not all investment in industrial buildings (asset 28 in Table 5.2), for example, is treated as investment in real property for tax purposes. Instead, a portion is personal property and receives a shorter recovery period. Thus, we show an average recovery period of 15.5 years, while Fullerton (1987) treats all investment in industrial buildings as investment in real property, and consequently assigns it a 19 year recovery period.

The International Trade Commission (1986) has computed the cost of capital and effective tax rates under prior law and several reform proposals for each of the 51 assets in Table 5.2. However, their cost recovery classification is a simple mapping from Fullerton (1987). Thus, our classification captures considerably more detail than that used by the International Trade Commission. Furthermore, the Commission's analysis compares prior law with reform proposals which differed substantially from the final version of the Tax Reform Act of 1986.[10]

Tax reform expands the number of recovery classes from five to eight. Based on ADR midpoints, personal property is assigned a recovery period ranging from 3 to 20 years. Property with recovery periods of 3, 5, 7, or 10 years receives allowances based on the 200 percent declining balance method, with an optimal switch to the straight-line method. Property with recovery periods of 15 and 20 years (primarily public utility property under ACRS), receives allowances based on the 150 percent declining balance method, with an optimal switch to the straight line method. Residential real property receives straight line over 27.5 years and nonresidential real property receives straight line over 31.5 years. As under prior law, recovery allowances are based on historic cost. The average recovery period in the corporate sector for each of 51 types of depreciable property is shown in Table 5.2. In general, tax reform lengthens recover periods. However, this effect is somewhat offset for most equipment by the generous 200 percent declining balance method allowed under tax reform.

C. Corporate and Individual Income Tax Rates[11]

Under prior, or pre-tax reform law, the top federal statutory rate was 46 percent. State corporate income taxes average .066 (King and Fullerton (1984)). Deductibility of state taxes at the federal level implies an overall statutory rate of .46+.066(1-.46), which equals .495. Tax reform lowers the top Federal statutory rate to .34. Thus, the overall corporate statutory rate for tax reform is .34+.066(1-.34), which equals .383.

Personal income taxes under prior law are based on a progressive structure composed of 14 brackets with a 50 percent maximum rate. Tax reform reduces the number of brackets to two with statutory rates of 15 and 28 percent. The top statutory rate, however, is 33 percent because a 5 percent surcharge is used to remove the benefits of the 15 percent rate and the personal exemption for high income taxpayers. Using the Treasury Individual Tax Model[12] James Cilke calculated the weighted average marginal personal income tax rates at the Federal level for interest, dividend, long-term capital gains, and noncorporate business income, as well as the rate at which households take deductions, for both prior law and tax reform. The results of these tabulations are shown in the "Federal Only" column of Table 5.3.

Tax reform generally lowers federal average marginal personal tax rates on capital income. An important exception, however, is the tax rate on realized long-term capital gains. Because 60 percent of long term gains are excluded under prior law, realized long-term gains are taxed at a maximum rate of 20 percent. Tax reform eliminates this exclusion and taxes realized long-term capital gains as ordinary income, with a maximum statutory rate of 33 percent. Thus, the average marginal rate on realized gains rises accordingly, from 16.4 percent under prior law to 26.7 percent under tax reform.

Tax reform also reduces the number of itemizers. Thus, the fraction of property taxes deducted on federal income tax returns, λ, falls from .48 under prior law to .41 under tax reform.

The personal tax rates from the Treasury Individual Tax Model are modified as in King and Fullerton (1984) to reflect taxation at the state and local level, deferral of capital gains, and the taxation of banks, life insurance companies, and nonprofit institutions.[13] The adjusted personal rates used in our cost of capital calculations are shown in the "After Adjustment" column of Table 5.3. As with the unadjusted rates, tax reform lowers the adjusted personal tax rates on all types of capital income except accrued capital gains.

Table 5.3 **Personal Tax Rates**

	Federal Only		After Adjustment	
Type of Income	Prior Law	Tax Reform	Prior Law	Tax Reform
Interest	.255	.216	.219	.194
Dividends	.329	.258	.285	.232
Capital Gains	.164	.267	.074	.125
Noncorporate	.250	.210	.300	.260
Housing Deductions	.209	.175	.259	.225

Source: Treasury Individual Tax Model, as described in the text.

D. Financing Shares

Financing shares are assumed invariant in the face of tax reform. For most calculations, we assume that firms finance marginal investments in the same way they as they financed the existing capital stock. Fullerton and Henderson (1984) cite data which suggests that noncorporate firms and homeowners finance one third of investment using debt and two thirds using equity. King and Fullerton (1984) indicate that corporations also finance using one third debt and two thirds equity. Corporate equity, in turn, is 93 percent retentions and 7 percent new share issues. Because of the small weight put on new share issues, these corporate sector financing shares are consistent with the new view of Auerbach (1979), Bradford (1981) and King (1977) that the dividend tax is not an important additional source of distortion in the allocation of investment between the corporate sector and the rest of the economy. This view of the dividend tax is controversial, and others argue that dividend payout rates affect the cost of capital, and that there is significant double taxation of corporations because profits are taxed once at the firm level and again when distributed as dividends (McLure (1979)). Therefore, we consider an alternative financing assumption which puts more weight on new share issues. Results for several additional financing arrangements also are reported below.

E. Local Property Taxes

Like capital stock weights, economic depreciation rates, state income tax rates, and financing shares, local property tax rates are assumed unchanged by tax reform. Based on Fullerton and Henderson (1984) we use economy wide averages of .008 for equipment and inventories, .011 for business land and structures, .016 for public utilities, and .018 for residential land and structures.

IV. INVESTMENT INCENTIVES BY ASSET, SECTOR, AND INDUSTRY: PRIOR LAW COMPARED WITH THE TAX REFORM ACT OF 1986

In this section we first present detailed results on investment incentives for each of 54 assets under prior law and tax reform. To keep the discussion manageable, these asset specific results are reported only for the corporate sector. Next, we report more aggregate results showing relative investment incentives for broad asset categories, as well as overall. in the corporate sector, the noncorporate sector. and the owner-occupied housing sector. Finally. we discuss marginal investment incentives for each of 60 private industries under both prior law and tax reform.

A. Present Value of Recovery Allowances by Asset

Table 5.4 shows the present value of depreciation allowances (columns 1 and 2), the present value of total cost recovery allowances under prior law (column 3), and the present value of allowances based on real economic depreciation (column 4) for each of 51 depreciable assets in the corporate sector. These calculations abstract from the effect of income tax rates on the discount rate by using a common 8 percent nominal discount rate for both prior law and tax reform. The present value of real economic depreciation is calculated using a 4 percent real rate of return.

Column 1 of Table 5.4 shows the present value of depreciation under prior law. Comparing column 1 with column 4 shows that prior law generally gives depreciation allowances more generous than allowances based on economic depreciation. This is true for both equipment (assets 1-27) as well as structures like assets (28-51).

For equipment, tax reform has a relatively small, but variable, effect on the present value of depreciation allowances, compared with those under prior law. For types of equipment such as office computing machinery (asset 14), which maintain the same recovery periods under tax reform as under prior law, but receive allowances based on the more generous 200 percent declining balance method, tax reform raises the present value of depreciation allowances. For other categories of equipment, such as construction tractors (asset 7) and photographic instruments (asset 26), the effect of the more generous method is offset partially by a longer life, and the present value of depreciation allowances rise, but by a slightly smaller amount. For other types of equipment, such as farm tractors (asset 6) and railroad equipment (asset 24), the more generous method is insufficient to offset the longer recovery period, and the present value of allowances fall. In addition, certain components of equipment-like assets (1-27) are real property (or ACRS public utility property) for which tax reform reduces the present value of allowances, as discussed below. On the whole, for equipment, tax reform reduces the present value of depreciation allowances more often than it raises the present value of depreciation allowances. However, allowances typically remain more generous than those based on economic depreciation.

In contrast to its effect on equipment, tax reform sharply reduces the present value of depreciation allowances for most structure-like assets (27-51), compared with prior law levels. This largely is due to the combination of a long recovery period for real property (raised from 19 to 27.5 years for residential real property and from 19 to 31.5 years for nonresidential real property), and the switch from the 175 percent declining balance method to the straight line method. For components of certain public utility structures (assets 40-44) the reduction in the present value of depreciation allowances also reflects the longer lives assigned to some 150 percent declining balance utility property, as well as the reclassification of some property from 150 percent declining balance over 15 years under ACRS to

Table 5.4 Present Value of Cost Recovery Allowances for Corporate Assets[a]

Assets	Present Value of Depreciation Allowances[a]		Present Value of Total Cost Recovery Allowances Under Prior Law[b]	Present Value of Economic[b] Depreciation[b]
	Prior Law	Tax Reform		
1. Furniture & Fixtures (Household)	.846	.864	1.006	.733
2. Furniture & Fixtures (Other)	.846	.819	1.006	.733
3. Fabricated Metal Products	.837	.834	.997	.692
4. Steam Engines and Turbines	.713	.624	.879	.667
5. Internal Combustion Engines	.776	.710	.939	.655
6. Farm Tractors	.846	.831	1.006	.801
7. Construction Tractors	.846	.865	1.006	.803
8. Other Agricultural Machinery	.846	.819	1.006	.708
9. Other Construction Machinery	.846	.860	1.006	.810
10. Mining and Oilfield Machinery	.846	.820	1.006	.808
11. Metalworking Machinery	.861	.849	1.006	.755
12. Special Industry Machinery	.849	.830	1.005	.718
13. General Industrial Equipment	.841	.815	.998	.753
14. Office Computing Machinery	.846	.869	1.006	.872
15. Service Industry Machinery	.843	.863	1.003	.806
16. Communications Equipment	.784	.746	.947	.742
17. Elec. Trans., Dist., & Indus. Appar.	.784	.748	.945	.669
18. Electric Household Appliances	.846	.869	1.006	.747
19. Other Electrical Equipment	.846	.864	1.006	.744
20. Trucks, Buses and Truck Trailers	.893	.869	1.005	.863
21. Autos	.911	.869	1.005	.893
22. Aircraft	.846	.819	1.006	.821
23. Ships & Boats	.846	.756	1.006	.652
24. Railroad Equipment	.846	.819	1.006	.623
25. Scientific & Engin. Instruments	.815	.804	.976	.777
26. Photographic Instruments	.847	.864	1.007	.785
27. Other Nonresidential Equipment	.846	.861	1.006	.785
28. Industrial Buildings	.643	.477	.685	.474
29. Mobile Commercial Offices	.575	.365	.575	.667
30. Commercial Office Buildings	.575	.365	.575	.385
31. Commercial Warehouses	.575	.365	.575	.385
32. Other Commercial Buildings	.756	.688	.866	.394
33. Religious Buildings	.575	.365	.575	.322
34. Educational Buildings	.575	.365	.575	.322
35. Hospital and Institut. Buildings	.575	.365	.575	.365
36. Hotels and Motels	.575	.365	.575	.529
37. Amusement and Recreational	.722	.678	.888	.524
38. Other Nonfarm Buildings	.575	.365	.575	.529
39. Railroads	.846	.819	1.006	.429
40. Telephone and Telegraph	.731	.690	.857	.444
41. Electric Light and Power	.661	.567	.830	.444
42. Gas	.688	.556	.784	.444
43. Local Transit	.846	.869	1.006	.444
44. Petroleum Pipelines	.846	.615	1.006	.444
45. Farm	.575	.535	.575	.375
46. Oil & Gas Explor, Shafts & Wells	.846	.819	1.006	.583
47. Other Mining Shafts and Wells	.846	.819	1.006	.583
48. Other Nonresidential Structures	.575	.365	.575	.420
49. Railroad Replacement Track	.846	.819	1.006	.444
50. Nuclear Fuel	.846	.869	1.006	.862
51. Residential Structures	.576	.405	.578	.474

Source: Authors' calculations as described in the text.

[a] Calculations use an 8% nominal discount rate, composed of a 4 percent inflation rate and a 4 percent real return.

[b] Computed as a z + (k/u).

[c] Uses depreciation rates from Table 2. Economic depreciation allowances are indexed for inflation.

straight line over 31.5 years under tax reform. For several types of structures, such as commercial office buildings (assets 29 and 30) and hotels (asset 36), tax reform reduces the present value of depreciation allowances below that based on economic depreciation.

Table 5.4 also shows the present value of total capital cost recovery allowances under prior law. Total recovery allowances measure the value of both depreciation and the investment tax credit. Due to the ITC, the present value of total prior law recovery allowances exceeds the present value of prior law depreciation allowances alone. Comparing column 3 (total recovery allowances) with column 4 (economic depreciation allowances) shows that prior law total cost recovery allowances are generally much more generous than those justified by real economic decay, especially for equipment. Indeed, for many types of equipment the present value of total recovery allowances slightly exceeds unity, so cost recovery is slightly more generous than expensing.

As tax reform repeals the ITC, total recovery allowances are equal to statutory depreciation allowances. Thus, tax reform reduces total cost recovery allowances more than depreciation allowances, compared to prior law levels. Compared with prior law, tax reform pushes total cost recovery allowances towards real economic allowances for all depreciable assets, although it overshoots the mark for a few types of equipment and for several types of structures.

B. Investment Incentives by Asset in the Corporate Sector

In the interest of tractability, we limit our presentation of cost of capital/effective tax rate results to those based on: (1) individual arbitrage, (2) new view financing assumptions, (3) inflation at a 4 percent rate, and (4) a 5 percent real required after all tax rate of return. There is nothing especially compelling about this particular set of assumptions, and results for a variety of alternative assumptions are considered below.

Table 5.5 shows the cost of capital (columns 1 and 2) and effective tax rate (columns 3 and 4) for each of 54 assets (51 depreciable assets plus inventories and two types of land) in the corporate sector. In contrast to the present value of depreciation allowances, the cost of capital or effective tax rate is a comprehensive measure of investment incentives. It fully captures the effects of corporate and personal income taxes at the Federal, state, and local levels, as well as the effects of depreciation allowances, tax credits, and property taxes.

Under prior law, costs of capital in the corporate sector range from a low of 5.3 percent for investment in autos (asset 21) and railroad equipment (asset 24), to a high of 11.1 percent for investment in mobile commercial office buildings (asset 29). Similarly, effective tax rates are lowest for autos (6.3 percent) and railroad equipment (6.5 percent, where the difference from autos is due to rounding), and highest for mobile commercial office buildings (55 percent). Table 5.5 also shows that because of generous total

Table 5.5 Asset Specific Investment Incentives in the Corporate Sector*

	Cost of Capital		Effective Tax Rate	
Asset	Prior Law	Tax Reform	Prior Law	Tax Reform
1. Furniture & Fixtures (Household)	.054	.075	.068	.335
2. Furniture & Fixtures (Other)	.054	.080	.068	.377
3. Fabricated Metal Products	.054	.075	.080	.337
4. Steam Engines and Turbines	.068	.092	.267	.457
5. Internal Combustion Engines	.059	.082	.159	.393
6. Farm Tractors	.054	.085	.070	.410
7. Construction Tractors	.054	.080	.070	.375
8. Other Agricultural Machinery	.054	.079	.067	.364
9. Other Construction Machinery	.054	.081	.071	.385
10. Mining and Oilfield Machinery	.054	.088	.071	.429
11. Metalworking Machinery	.054	.078	.066	.356
12. Special Industry Machinery	.054	.078	.067	.358
13. General Industrial Equipment	.054	.081	.081	.380
14. Office Computing Machinery	.054	.090	.076	.443
15. Service Industry Machinery	.054	.080	.075	.377
16. Communications Equipment	.063	.088	.200	.433
17. Elec. Trans., Dist., & Indus. Appar.	.058	.080	.141	.374
18. Electric Household Appliances	.054	.075	.068	.338
19. Other Electrical Equipment	.054	.076	.068	.340
20. Trucks, Buses and Truck Trailers	.054	.088	.066	.432
21. Autos	.053	.095	.063	.476
22. Aircraft	.054	.089	.072	.441
23. Ships & Boats	.054	.081	.066	.384
24. Railroad Equipment	.053	.075	.065	.331
25. Scientific & Engin. Instruments	.057	.083	.121	.397
26. Photographic Instruments	.054	.079	.069	.364
27. Other Nonresidential Equipment	.054	.079	.070	.367
28. Industrial Buildings	.080	.091	.373	.453
29. Mobile Commercial Offices	.111	.119	.550	.579
30. Commercial Office Buildings	.087	.096	.427	.477
31. Commercial Warehouses	.087	.096	.427	.477
32. Other Commercial Buildings	.065	.078	.228	.358
33. Religious Buildings	.085	.093	.408	.461
34. Educational Buildings	.085	.093	.408	.461
35. Hospital and Institut. Buildings	.086	.095	.421	.473
36. Hotels and Motels	.096	.104	.479	.520
37. Amusement and Recreational	.068	.082	.262	.394
38. Other Nonfarm Buildings	.096	.104	.479	.520
39. Railroads	.057	.074	.122	.322
40. Telephone and Telegraph	.073	.085	.315	.415
41. Electric Light and Power	.075	.092	.334	.458
42. Gas	.079	.093	.365	.460
43. Local Transit	.061	.075	.183	.337
44. Petroleum Pipelines	.061	.090	.183	.443
45. Farm	.087	.087	.424	.427
46. Oil & Gas Explor., Shafts & Wells	.057	.077	.123	.351
47. Other Mining Shafts and Wells	.057	.077	.123	.351
48. Other Nonresidential Structures	.089	.097	.438	.486
49. Railroad Replacement Track	.057	.074	.122	.324
50. Nuclear Fuel	.058	.091	.133	.452
51. Residential Structures	.099	.105	.495	.525
52. Nonresidential Land	.101	.096	.506	.478
53. Residential Land	.108	.103	.539	.514
54. Inventories	.098	.092	.488	.458

Source: Authors' calculations as discussed in the text.

*Calculations assume $s = .05$, $\pi = .04$.

cost recovery allowances (accelerated depreciation plus the ITC) effective tax rates on equipment tend to be lower than on those on other assets.

For structures which generally do not receive the ITC (assets 28-39 and 45-51), effective tax rates tend to be higher and less diverse than for equipment. Public utility structures (assets 40-44), many of which are eligible for the ITC under prior law, generally have effective tax rates somewhere between those on equipment and those on other structures.

Finally, nondepreciable land and inventories (assets 52-54) receive neither accelerated depreciation nor the ITC. Thus, they have costs of capital and effective tax rates which are higher then those on most types of depreciable property (assets 1-51).

Table 5.5 shows that tax reform raises the cost of capital and effective tax rate for corporate investment in all types of depreciable property. Thus, for equipment and structures, the effect of less generous cost recovery allowances combined with a higher capital gains tax rate offsets the combined effect of reductions in the corporate income tax rate and in the rate on dividends.[14] Effective tax rates tend to rise most dramatically for equipment, due to ITC repeal. Nonetheless, equipment still generally faces lower effective tax rates than those on other assets.

In contrast to its effect on depreciable property, tax reform lowers the cost of capital and effective tax rate for investment in nondepreciating land and inventories. These assets benefit from the 11.2 percentage point reduction in the statutory rate on corporate income, but are not penalized by less generous cost recovery allowances. However, these assets still face higher effective tax rates than on most types of depreciable property.

C. Investment Incentives by Sector and Industry

Table 5.6 shows summary measures of investment incentives for broad asset categories, as well as overall, in the corporate, noncorporate business, and owner-occupied housing sectors. These summary measures are calculated using capital weighted averages of the cost of capital, and are useful in highlighting a number of points.

In particular, Table 5.6 shows that the overall average effective tax rate in the corporate sector was 38.7 percent under prior law, substantially below the 49.5 percent statutory rate. In the noncorporate sector the overall average effective rate was lower than in the corporate sector, 33.2 percent, but above the 30.0 percent statutory rate on noncorporate business income. The effective tax rate on owner-occupied housing was lower still, 22.5 percent (it is positive due to property taxes).

In the corporate sector, tax reform increases the overall average effective rate by 5.7 percentage points (or 14.7 percent) to a 44.4 percent rate, which is now above the statutory rate of 38.3 percent. In the noncorporate sector the overall average effective rate rises more modestly, by 0.7 percentage points (or 2.1 percent), to a 33.9 percent rate, but stays above the new statutory rate on noncorporate business income of 26.0 percent.

Table 5.6 **Summary Measures**[a]

	Prior Law	Tax Reform
Corporate Sector Tax Rates		
Equipment[b]	.100	.396
Structures		
Non-residential[c]	.344	.431
Residential[d]	.495	.525
Public Utility[e]	.326	.445
Inventories	.488	.458
Land		
Non-residential	.506	.478
Residential	.539	.514
Overall[f]	.387	.444
Noncorporate Tax Rates		
Equipment[b]	-.119	.254
Structures		
Non-residential[c]	.278	.314
Residential[d]	.382	.406
Public Utility[e]	.221	.336
Inventories	.330	.305
Land		
Non-residential	.361	.338
Residential	.414	.395
Overall[f]	.332	.339
Owner-Occupied Housing Tax Rate	.225	.237
Overall Tax Rate[f]	.333	.365
Standard Deviation of Cost of Capital	.0150	.0114

Source: Authors' calculations as described in the text.

[a] Calculations assume $s=0.05$ and $\pi=0.04$.

[b] Equipment includes all assets 1-27, even though components of several of these assets can be identified as real property.

[c] Non-residential structures includes all assets 28-39 and 45-50, even though components of several are not treated as real property.

[d] This is asset 51.

[e] This includes assets 40-44.

[f] Asset 50, nuclear fuel, is included in the overall average, even though it is not an element of any subcategory.

We also see from Table 5.6 that under prior law investment incentives in both the corporate and the noncorporate sector were biased in favor of depreciable property, especially equipment, compared to nondepreciable property: an exception is residential structures in the noncorporate sector.

Tax reform has a qualitatively similar influence on average effective tax rates in both the corporate and the noncorporate sector. Effective rates on depreciable property, especially equipment, are increased by tax reform, while the effective rates on nondepreciating land and inventories are reduced due to rate reduction. On average, in both sectors, equipment remains the most favored investment after tax reform, and depreciable property (other than residential structures) is favored compared to investment in nondepreciable land. Inventories, which are predominantly a corporate sector asset, continue to be taxed at an above average rate in the corporate sector, but at a below average rate in the noncorporate sector. Finally, residential structures, which are predominantly used in the noncorporate sector, continue to be taxed at an above average rate.

Because of rate reduction and a reduction in the number of itemizers, tax reform increases the effective tax rate on owner-occupied housing by 1.2 percentage points (5.3 percent), to a 23.7 percent rate under tax reform. Thus, in all three sectors overall average effective tax rates rise as a result of tax reform. However, as under prior law, corporate sector investment tends to face higher effective tax rates than those on investment in other sectors. Overall, tax reform increases the economy wide average effective tax rate by 3.2 percentage points (9.6 percent), from a 33.3 percent rate under prior law to a 36.5 percent rate. This suggests that corporate and personal rate reduction is insufficient to offset the effects of ITC repeal, less generous depreciation allowances, and the taxation of capital gains as ordinary income. Table 5.6 includes a calculation of the capital stock weighted standard deviation of the cost of capital across all assets and sectors. Under a perfectly uniform tax system, the cost of capital would not vary across alternative investments, and capital would be efficiently allocated across assets and sectors. In this case the standard deviation in the cost of capital would be zero. All else constant, increases in the standard deviation reflect reductions in uniformity.[15]

Under prior law and tax reform. nonneutralities exist due to differential taxation of assets within each sector, as well as differences in the tax treatment of investments in different sectors. Interasset and intersectoral distortions combine to give a standard deviation in the cost of capital of 0.0150 under prior law.

Our calculation suggests that tax reform reduces deviations in the cost of capital across assets and sectors by 24 percent, to 0.0114. This is the result of four primary influences. First, repeal of the ITC reduces existing biases in favor of equipment. Second, less generous total cost recovery allowances reduce existing biases in favor of depreciable property relative to land and inventories. Third, because there is no offsetting fall in the value of depreciation allowances (uz), rate reduction primarily benefits non-depreciating land and inventories. This further reduces the (relative) advantage of depreciable compared with nondepreciable investment. Fourth, the reduction in personal rates and in the number of itemizers reduces the tax advantages of owner-occupied housing compared with investment in the noncorporate sector. However, some effects work in the opposite direction. Tax reform widens the difference between the overall average effective tax rate in the corporate sector compared with that in the noncorporate sector and that in the owner-occupied housing sector. In addition, tax reform increases the diversity in the tax treatment of various types of equipment, especially within the corporate sector. Nonetheless, on the whole capital is allocated more efficiently under tax reform than under prior law, as shown by a lower standard deviation of the cost of capital.

Table 5.7 shows the cost of capital and effective tax rate for each of 60 industries. Under prior law, effective tax rates range from 14 percent in the water transportation industry to 43.8 percent in the production of transportation equipment other than motor vehicles. In general, under prior law rates tend to be higher in heavily corporate industries, such as manufacturing, than in noncorporate industries, such as services.

Tax reform would generally raise industry effective tax rates, while changing the relative treatment of industries and tightening the distribution. The lowest effective rate is 33.1 percent in agriculture, reflecting the benefit of rate reduction for nondepreciable land. The highest effective tax rate is 45.9 percent for the insurance industry. In general, heavily corporate industries, such as manufacturing, continue to face above average effective tax rates.

V. THE EFFECTS OF THE COMPONENTS OF TAX REFORM

The net effect of the 1986 tax reform act on investment incentives is a combination of the effects from corporate rate reduction, ITC repeal, changes in depreciation allowances, and personal rate reduction. It is interesting to look at the effect on investment incentives of each of these separate components of tax reform. The results of this analysis are reported in Table 5.8. The first column of Table 5.8 reprints the prior law column of Table 5.6. Each succeeding column in Table 5.8 shows the effective tax rate for the change indicated by the column heading.

A. Corporate Rate Reduction

These calculations maintain the ITC. ACRS. and prior law personal tax rates. The tax rate on corporate income is lowered. however. by 11.2 percentage points (or 22.6 percent) to its 38.3 percent rate under tax reform. With the lower statutory corporate rate, the overall average effective tax

Table 5.7 Cost of Capital and Effective Tax Rate by Industry*

Industry	Prior Law		Tax Reform	
	Cost of Capital	Effective Tax Rate	Cost of Capital	Effective Tax Rate
1. Farms	.076	.340	.075	.331
2. Agriculture Serv., Forestry & Fish	.077	.352	.078	.361
3. Metal Mining	.075	.329	.091	.449
4. Coal Mining	.069	.271	.089	.438
5. Oil and Gas Extraction	.065	.226	.080	.376
6. Nonmetalic Minerals	.072	.307	.089	.439
7. Construction	.084	.403	.086	.418
8. Lumber and Wood Products	.079	.369	.088	.429
9. Furniture and Fixtures	.085	.409	.091	.452
10. Stone, Clay and Glass Products	.082	.393	.090	.443
11. Primary Metal Industries	.086	.419	.089	.441
12. Fabricated Metal Products	.086	.416	.090	.445
13. Nonelectrical Machinery	.086	.417	.090	.445
14. Electric and Electronic Equip.	.086	.417	.090	.447
15. Other Vehicles and Equipment	.080	.374	.089	.438
16. Other Transportation Equipment	.089	.438	.091	.449
17. Instruments	.087	.425	.091	.449
18. Misc. Manufacturing Industries	.070	.288	.087	.425
19. Food and Kindred Products	.085	.411	.090	.445
20. Tobacco Manufacturers	.085	.413	.090	.444
21. Textile Mill Products	.083	.397	.089	.437
22. Apparel	.082	.390	.088	.429
23. Paper Products	.076	.338	.087	.426
24. Printing and Publishing	.077	.351	.088	.430
25. Chemicals	.073	.312	.083	.397
26. Petroleum and Coal Products	.075	.330	.087	.426
27. Rubber and Misc. Plastic Products	.078	.361	.088	.431
28. Leather	.084	.407	.089	.440
29. Railroad Transportation	.060	.161	.076	.342
30. Land Passenger Transportation	.065	.230	.079	.367
31. Trucking and Warehousing	.066	.237	.082	.387
32. Water Transportation	.058	.140	.080	.376
33. Airlines	.061	.175	.090	.447
34. Nongas Pipelines	.064	.218	.090	.444
35. Transportation Services	.060	.164	.075	.333
36. Telephone and Telegraph	.070	.284	.087	.427
37. Radio and TV Broadcasting	.066	.242	.087	.424
38. Electric Utilities	.074	.324	.088	.435
39. Gas Utilities	.078	.361	.092	.456
40. Sanitation Utilities	.079	.369	.085	.414
41. Wholesale Trade	.079	.365	.081	.380
42. Retail Trade	.086	.416	.086	.417
43. Commercial and Mutual Banks	.073	.312	.088	.430
44. Other Credit Agencies	.068	.264	.086	.420
45. Security and Commodity Services	.078	.360	.082	.394
46. Insurance Carriers	.078	.363	.092	.459
47. Insurance Agents and Services	.076	.344	.078	.358
48. Real Estate	.081	.386	.083	.396
49. Investment and Holding Co.	.075	.335	.078	.362
50. Hotels and Motels	.082	.391	.092	.455
51. Personal Services	.069	.271	.080	.373
52. Business Services	.062	.192	.085	.412
53. Auto Repair Services	.059	.151	.083	.398
54. Misc. Repair Services	.063	.211	.077	.350
55. Motion Pictures	.064	.219	.083	.395
56. Amusement & Recreational Services	.063	.209	.079	.366
57. Health Services	.068	.265	.081	.382
58. Legal Services	.068	.265	.076	.338
59. Educational Services	.064	.222	.083	.396
60. Social & Professional Services	.075	.337	.084	.404

Source: Authors' calculation as described in the text.

*Calculations are for a capital weighted average of the corporate and noncorporate sectors of each industry, and assume $s=0.05$ and $\pi=0.04$.

Table 5.8 **Components of Tax Reform***

	Change From Prior Law				
	Prior Law	Corp. Rate Reduction	ITC Repeal	1986 Act Depreciation	Pers. Rate Reduction
Corporate Tax Rates					
Equipment	.100	.063	.396	.145	.149
Structures					
Non-residential	.344	.319	.385	.417	.373
Residential	.495	.459	.495	.557	.515
Public Utility	.326	.307	.412	.383	.355
Inventories	.488	.435	.488	.488	.513
Land					
Non-residential	.506	.457	.506	.506	.529
Residential	.539	.496	.539	.539	.559
Overall	.387	.343	.447	.414	.416
Noncorporate Tax Rates					
Equipment	-.119	-.119	.265	-.100	-.142
Structures					
Non-residential	.278	.278	.293	.321	.263
Residential	.382	.382	.383	.426	.366
Public Utility	.221	.221	.326	.254	.208
Inventories	.330	.330	.330	.330	.305
Land					
Non-residential	.361	.361	.361	.361	.338
Residential	.414	.414	.414	.414	.395
Overall	.332	.332	.349	.345	.311
Owner-Occupied Housing Tax Rate	.225	.225	.225	.225	.233
Overall Tax Rate	.333	.312	.368	.350	.341
Standard Deviation of Cost of Capital	.0150	.0125	.0124	.0162	.0161

Source: Authors' calculations as described in the text. In each column, only one component is simulated.

*Calculations assume $s=0.05$, $\pi=0.04$.

rate in the corporate sector falls by 4.4 percentage points (11.4 percent), from a 38.7 percent rate under prior law to a 34.3 percent rate. This relatively small fall in the effective tax rate is due in part to issues involving debt finance. While corporate rate reduction lowers the taxation of earnings. it also reduces the benefit of interest deductibility on the one-third of corporate investment that is financed by debt. If instead we assume 100 percent equity financing, then the effective tax rate in the corporate sector would fall more substantially, from a 52 percent effective rate under prior law to a 44 percent effective rate under tax reform (a reduction of 15.4 percent).

For two reasons corporate rate reduction also promotes neutrality, as indicated by a fall in the standard deviation of the cost of capital, compared to prior law. First, rate reduction lowers effective tax rates in the corporate sector compared with the already lower effective tax rates in the noncorporate and owner-occupied housing sectors. Second, because statutory rate reduction lowers the value of accelerated depreciation allowances, it reduces the cost of capital for depreciable assets by a smaller proportional amount than it reduces the cost of capital for land and inventories. Thus, a fall in the statutory corporate rate reduces corporate sector incentives to invest in equipment and structures relative to land and inventories.

B. ITC Repeal

For these calculations prior law is maintained except for the ITC, which is eliminated for all assets. ITC repeal by itself significantly raises effective tax rates on equipment and public utility property, compared to prior law. This is especially important in the corporate sector where most equipment and public utility property is employed. ITC repeal raises the overall corporate effective rate by six percentage points (15.5 percent) to a 44.7 percent rate from the 38.7 percent rate under prior law. Thus, the increase in corporate sector effective tax rates due to ITC repeal more than offsets the fall in corporate sector effective tax rates due to statutory rate reduction.

Because of the smaller weight on equipment and public utility property, ITC repeal has a less dramatic effect in the noncorporate sector, and the overall effective tax rate there rises by only 1.7 percentage points (5.1 percent). The overall economy wide average effective tax rate rises by 3.5 percentage points (10.5 percent), from a 33.3 percent rate to a 36.8 percent rate.

By itself, ITC repeal also promotes uniform taxation of capital, compared to prior law, as shown by the reduction in the standard deviation of the cost of capital. In particular, ITC repeal goes a long way towards equalizing the tax treatment of equipment relative to structures, as well as depreciable property relative to land and inventories.[16]

C. Depreciation Allowances

For this comparison, ACRS recovery classes are replaced by the 1986 Act cost recovery classes, but the ITC is maintained. In general, tax reform recovery allowances are less generous than ACRS allowances. Not surprisingly, then, effective tax rates for depreciable property rise compared to prior law levels. Their increase is more dramatic in the corporate sector where depreciation allowances are valued at the relatively high 49.5 percent (combined) statutory tax rate, than in the noncorporate sector, where depreciation allowances are valued at the lower 30 percent rate on noncorporate business income. The new depreciation allowances raise the overall average effective tax rate in the corporate sector by 2.7 percentage points (7.0 percent) to a 41.4 percent rate. The overall average rate in the noncorporate sector rises less significantly, by 1.3 percentage points (3.9 percent). The smaller increase in the noncorporate compared with the corporate sector is due to the lower noncorporate statutory tax rate and the smaller ratio of depreciable to nondepreciable assets in noncorporate sector. The overall economy wide effective tax rate rises by 1.7 percentage points (5.1 percent) to a 35.0 percent rate.

By themselves, the new recovery allowances (without ITC repeal) slightly widen the dispersion of the cost of capital, compared with prior law. One reason for this is slightly larger intersectoral distortions. In addition, the new depreciation allowances generate further differences in the tax treatment of some disaggregate types of depreciable property (especially equipment), compared to prior law.

D. Personal Rate Reduction

For these calculations, prior law personal rates on capital income are replaced by the personal taxes obtained under tax reform. Somewhat surprisingly, personal rate "reduction" increases the overall average effective tax rate in the corporate sector by 2.9 percentage points (7.5 percent), to a rate of 41.6 percent. This increase is due to the emphasis given to retentions as a source of financing, in combination with the large (68.9 percent) increase in the tax rate on capital gains income. Since the tax rate on dividends falls, effective tax rates in the corporate sector could fall, rather than rise as indicated in Table 5.8, if new share financing represented a larger proportion of corporate equity financed investment.[17]

In the noncorporate sector, the overall average effective tax rate falls to by 2.1 percentage points (6.3 percent) to a rate of 31.1 percent. This is due to the reduction in the statutory tax rate on noncorporate business income. The effective tax rate on owner-occupied housing rises slightly, to 23.3 percent, due to a reduction in the rate at which property taxes are deducted and to a reduction in the fraction of homeowners who itemize. The overall average rate for the economy rises by 0.8 percentage points (2.4 percent), from 33.3 percent to 34.1 percent.

On the whole, personal rate reduction slightly increases the nonneutralities. This is due in large part to the increase in the rate on accrued capital gains, which substantially increases effective tax rates in the corporate sector compared to those in the noncorporate and owner-occupied housing sectors. In addition, the reduction in the rate on noncorporate business income further expands differences in the taxation of corporate sector investment compared with investment in the noncorporate sector.

VI. RESULTS FOR ALTERNATIVE ARBITRAGE, PROFITABILITY AND FINANCING ASSUMPTIONS

In this section we explore the effects of alternative arbitrage, rate of return, and financing assumptions on our measurement of investment incentives.

A. Individual vs. Firm Arbitrage

All calculations above use individual arbitrage. Table 5.9 compares effective tax rates based on individual arbitrage with those based on firm arbitrage. For both prior law and tax reform, overall average effective tax rates are reduced by using firm instead of individual arbitrage. In general, however, the more important are arbitrage assumptions, the larger is the disparity in the tax treatment of alternative investors. Tax reform improves neutrality. Thus, the choice of arbitrage assumptions has a smaller influence on overall average effective tax rates under tax reform than it did under prior law. This means, however, that the choice of arbitrage assumptions can be important in evaluating tax reform.[18]

Table 5.9 **Individual Arbitrage Compared with Firm Arbitrage***

	Individual Arbitrage		Firm Arbitrage	
	Prior Law	Tax Reform	Prior Law	Tax Reform
Corporate Tax Rates				
Equipment	.100	.396	-.104	.389
Structures				
Non-residential	.344	.431	.288	.423
Residential	.495	.525	.482	.531
Public Utility	.326	.445	.286	.444
Inventories	.488	.458	.422	.435
Land				
Non-residential	.506	.478	.453	.463
Residential	.539	.514	.506	.511
Overall	.387	.444	.313	.432
Noncorporate Tax Rates				
Equipment	-.119	.254	-.100	.240
Structures				
Non-residential	.278	.314	.263	.301
Residential	.382	.406	.361	.388
Public Utility	.221	.336	.201	.320
Inventories	.330	.305	.320	.296
Land				
Non-residential	.361	.338	.348	.326
Residential	.414	.395	.396	.379
Overall	.332	.339	.319	.326
Owner-Occupied Housing Tax Rate	.225	.237	.189	.207
Overall Tax Rate	.333	.365	.281	.335
Standard Deviation of Cost of Capital	.0150	.0114	.0177	.008

Source: Authors' calculations as described in the text.

*Calculations assume s=0.05 and 0.04.

Compared with prior law, tax reform causes a smaller rise in corporate effective tax rates under individual arbitrage (5.7 percentage points or 14.7 percent) than under firm arbitrage (11.9 percentage points or 38 percent). On average, the comparison between noncorporate sector effective rates under prior law with those under tax reform is unaffected by arbitrage assumptions. The rate on owner-occupied housing rises more for firm arbitrage than for individual arbitrage. Consequently, compared to prior law, tax reform increases the overall economy wide average effective rate more sharply under firm arbitrage (5.4 percentage points or 19.2 percent) than it does under individual arbitrage (3.2 percentage points or 9.6 percent). Under either arbitrage assumption, however, tax reform improves neutrality, as indicated by a lower standard deviation in the cost of capital.

B. Required Real After-Tax Return

Table 5.10 shows effective tax rates under prior law and tax reform for a low, 2 percent, return and a high, 8 percent, return, in addition to the 5 percent return assumed in earlier calculations. Lowering s from 5 percent to 2 percent raises overall average effective tax rates in all sectors under both prior law and tax reform. An increase in s from 5 percent to 8 percent lowers overall average effective tax rates in all sectors. Tax reform causes a smaller rise (both absolutely and on a percentage basis) in effective tax rates, compared to prior law levels, the higher is the real required net-of-tax return on investment. For all three values of s, tax reform improves neutrality compared with prior law.

C. Financing Assumptions

The calculations above assume marginal investments are financed like the existing capital stock. All sectors finance new investments with one-third debt and two-thirds equity. In addition, corporate equity is obtained mostly from retained earnings (93 percent), and less significantly from new share issues (7 percent), consistent with the "new view" that dividend taxation is relatively unimportant. However, we do not know how the marginal investment is financed, and therefore it seems desirable to explore the effects of alternative specifications. Fortunately, the Fullerton-Henderson model allows us to incorporate alternative financing arrangements simply by changing the weights in equations (5.2)-(5.4). In Table 5.11 we present results based on several alternative financing assumptions. For purposes of comparison, however, the first column of Table 5.11 shows effective tax rates for the one-third debt, two-third equity new view case analyzed earlier in Table 5.6.

Stiglitz (1973) has argued that marginal investments may be totally debt financed. Under both prior law and tax reform, debt financed investment in all three sectors is subsidized because interest payments are deducted at higher rates than those applied to subsequent interest receipts. In the

Table 5.10 Alternative Real Rates of Return*

	Low (S=2%)		Middle (S=5%)		High (S=8%)	
	Prior Law	Tax Reform	Prior Law	Tax Reform	Prior Law	Tax Reform
Corporate Tax Rates						
Equipment	-.034	.530	.100	.396	.145	.356
Structures						
Non-residential	.445	.554	.344	.431	.329	.397
Residential	.621	.656	.495	.525	.460	.480
Public Utility	.460	.582	.326	.445	.300	.405
Inventories	.516	.528	.488	.458	.481	.437
Land						
Non-residential	.554	.565	.506	.478	.493	.450
Residential	.615	.623	.539	.514	.515	.476
Overall	.435	.551	.387	.444	.381	.412
Noncorporate Tax Rates						
Equipment	-.448	.395	-.119	.254	-.048	.213
Structures						
Non-residential	.410	.450	.278	.314	.245	.275
Residential	.546	.568	.382	.406	.329	.348
Public Utility	.388	.498	.221	.336	.175	.286
Inventories	.399	.384	.330	.305	.310	.281
Land						
Non-residential	.457	.445	.361	.338	.331	.304
Residential	.545	.537	.414	.395	.368	.344
Overall	.439	.462	.332	.339	.301	.300
Owner-Occupied Housing Tax Rate	.429	.443	.225	.237	.149	.159
Overall Tax Rate	.435	.497	.333	.365	.305	.323
Standard Deviation of Cost of Capital	.0081	.0056	.0150	.0114	.0235	.0183

Source: Authors' calculations as described in the text.

*Calculations assume $\pi=0.04$ and individual arbitrage.

corporate sector under prior law interest payments are deducted at the 49.5 percent combined statutory rate. Corresponding interest receipts, however, are subject to taxation at a lower 21.9 percent rate, implying that corporate sector debt finance enjoys a subsidy equal to 27.6 percent of nominal interest payments. In the noncorporate sector, the subsidy equals 8.1 percent, and in the owner-occupied housing sector the subsidy equals 4 percent. Tax reform reduces to 18.9 percent the subsidy to corporate debt since it narrows the spread between the statutory corporate income tax rate (38.3 percent) and the tax rate on interest income (19.4 percent). Similarly, tax reform lowers the subsidy in the noncorporate sector to 6.6 percent. In the owner-occupied housing sector the subsidy falls to 3.1 percent as a result of tax reform.

Column 2 of Table 5.11 shows effective total tax rates for investments financed using debt alone. With 100 percent debt finance, effective tax rates are reduced substantially below those in column one, where the subsidy on debt

Table 5.11 Alternative Financing[a]

	One-Third Debt, Two-Thirds Equity, New View[b]		All Debt[c]		All Equity[d]		One Third Debt, Two-Thirds Equity, Old View[e]		External Finance[f]	
	Prior Law	Tax Reform	Prior Law	Tax Reform	Prior Law	Tax Reform	Prior Law	Tax Reform	Prior Law	Tax Reform
Corporate Tax Rates										
Equipment	.100	.396	-1.399	.042	.323	.493	.245	.433	.366	.471
Structures										
Non-residential	.344	.431	-.326	.092	.483	.524	.433	.467	.512	.503
Residential	.495	.525	.086	.280	.592	.596	.557	.552	.613	.580
Public Utility	.326	.445	-.297	.136	.465	.532	.414	.478	.494	.513
Inventories	.488	.458	-.144	.082	.600	.551	.561	.494	.623	.530
Land										
Non-residential	.506	.478	-.057	.139	.612	.565	.574	.511	.633	.546
Residential	.539	.514	.081	.233	.632	.590	.598	.543	.651	.573
Overall	.387	.444	-.339	.099	.522	.535	.474	.479	.549	.515
Noncorporate Tax Rates										
Equipment	-.119	.254	-.316	.184	-.040	.285	-.119	.254	-.119	.254
Structures										
Non-residential	.278	.314	.188	.250	.317	.342	.278	.314	.278	.314
Residential	.382	.406	.314	.356	.412	.428	.382	.406	.382	.406
Public Utility	.221	.336	.127	.278	.261	.362	.221	.336	.221	.336
Inventories	.330	.305	.240	.234	.368	.336	.330	.305	.330	.305
Land										
Non-residential	.361	.338	.279	.274	.395	.366	.361	.338	.361	.338
Residential	.414	.395	.346	.342	.443	.418	.414	.395	.414	.395
Overall	.332	.339	.248	.277	.368	.366	.332	.339	.332	.339
Owner-Occupied Housing Tax Rate	.225	.237	.187	.209	.243	.250	.225	.237	.225	.237
Overall Tax Rate	.333	.365	.067	.196	.418	.427	.377	.384	.423	.405
Standard Deviation of Rho	.0150	.0114	.0160	.0073	.0225	.0184	.0195	.0140	.0260	.0172

Source: Authors' calculations as described in the text.

[a] Calculations assumes $s=0.05$, $\pi=0.04$, and individual arbitrage.
[b] $C_d = 0.34$, $C_{re} = 0.61$, $C_{ns} = 0.05$
[c] $C_d = 1.00$, $C_{re} = 0.00$, $C_{ns} = 0.00$
[d] $C_d = 0.00$, $C_{re} = 0.93$, $C_{ns} = 0.07$
[e] $C_d = 0.34$, $C_{re} = 0.33$, $C_{ns} = 0.33$
[f] $C_d = 0.34$, $C_{re} = 0.00$, $C_{ns} = 0.66$

only applies to 33 cents on a one dollar marginal investment. For both tax regimes, debt finance reduces effective total tax rates more in the corporate sector than in the noncorporate sector because the higher statutory rate on corporate income means a larger subsidy in the corporate sector. However, tax reform reduces the subsidy to debt in all sectors. Thus, even with 100 percent debt finance, property taxes insure that effective total tax rates in all sectors remain positive under tax reform. In contrast, under prior law the overall influence of the subsidy to debt outweighs the influence of property taxes on corporate sector investment, and the corresponding overall average effective total tax rate is negative. The third column of Table 5.11 shows effective total tax rates for the other extreme of all equity financed marginal investments.

Charles McLure (1979), among others, has argued that dividend payout rates are important, and that the double taxation of dividends represents a significant disincentive to corporate sector investment. This perspective has been called the "old view" of dividend taxation. Initially, arguments against the old view and in favor the new view that dividend payout rates are unimportant were well received. However, subsequent empirical work has not given decisive support to either perspective on the importance of dividend taxes.[19]

During the 1980's, dividends as a fraction of after-tax corporate profits, the dividend payout ratio, have varied between .39 and .77 (Economic Report of the President, 1986, Table B-84). After refining the measure of profits by adjusting for the effect of inflation on the real cost of debt, Shoven (1986) finds that the long run equilibrium dividend payout ratio has varied between .30 and .37 over the period from 1960 to 1982.

We choose a 50 percent payout ratio as our interpretation of the old view that dividend taxes matter, and err on the side of a generous difference between discount rates under the old compared with the new view. To implement an analysis consistent with findings under the old view for a 50 percent dividend payout ratio we give equal weight to new share issues and retained earnings as sources of corporate equity. One third of corporate sector marginal investment remains financed using debt,[20] and financing in the noncorporate and owner-occupied housing sectors remains one-third debt and two-thirds equity.

The results of our old view calculations are shown in the fourth column of Table 5.11. Both for prior law and tax reform, the larger emphasis given to dividends relative to capital gains raises effective total tax rates in the corporate sector (and consequently for the entire economy), compared with new view levels. However, the spread between the dividends tax rate and the capital gains tax rate is wider under prior law than it is under tax reform. Thus, the corresponding increase in effective tax rates is greater under prior law (the overall corporate effective tax rate rises from .387 based on the new view to .474 based on the old view). than it is under tax reform (where old view assumptions raise the overall total effective tax rate in the corporate sector from .444 to .479). Furthermore, tax reform actually lowers the dividend tax compared to prior law. Thus, based on old view assumptions, tax reform only increases the overall average effective tax rate in the corporate sector by a scant 0.5 percentage points (1.1 percent), from a 47.4 percent rate under prior law to a 47.9 percent rate under tax reform. As a consequence, the overall economy wide average effective rate only rises by 1.9 percent, or about 20 percent of the 9.6 percent increase obtained under the new view. Therefore, neutrality is improved at the expense of a much smaller reduction in overall average incentives to save and invest under the old view than it is under the new view. Tax reform compares more favorably with prior law when dividend taxes are more important.

The fifth column of Table 5.11 shows effective total tax rates when retained earnings are unavailable as a source for financing marginal investments. It may be, for example, that required dividend payments make retained earnings unavailable for financing extra investment, at least for some corporations. These corporations must finance new marginal investment externally, by issuing either new shares or debt. In these calculations, we assume that corporate financing of real investment is one-third debt and two-thirds new share issues. Investment in the noncorporate business sector and the owner-occupied housing sector remains one-third debt, two-thirds equity.

When marginal corporate investments are financed externally, tax reform actually reduces the overall total corporate sector effective tax rate from 54.9 percent under prior law to 51.5 percent. This 3.4 percentage point reduction is due to the reform-induced fall in the dividend tax.

VII. INFLATION, EFFECTIVE TAX RATES, AND INDEXATION

So far, we have performed all calculations using a 4 percent inflation rate. It is important, however, to see how variations in inflation affect investment incentives.

A. Influence of Inflation on Effective Tax Rates Under Prior Law and Tax Reform

Under both prior law and tax reform, inflation influences effective tax rates through at least three channels. First, inflation reduces the real value of recovery allowances, which are based on historic cost and not indexed for inflation. This increases effective tax rates on depreciable property. Second, in the corporate sector inflation increases effective tax rates because purely inflationary distributions and retained earnings are subject to tax. However, a third effect works in the opposite direction. In all three sectors, nominal interest payments are deducted at a higher rate than applied to interest receipts, and therefore are subsidized. Since inflation increases nominal interest payments, it increases this subsidy to debt, thus lowering effective tax rates.

Panel 1 of Table 5.12 shows that prior law effective tax rates exhibit varying responses to rising inflation. Because recovery allowances are unindexed, effective tax rates on depreciable property rise with inflation. The effective tax rate on corporate equipment, for example, increases from -8.9 percent to +21.4 percent as inflation rises from a zero percent to an 8 percent rate. In contrast to depreciable property, effective tax rates on nondepreciable land and inventories fall with inflation, due to the rising

Table 5.12 **Influence of Inflation on Effective Tax Rates**[a]

Inflation Rate	0%	4%	8%
1. Prior Law			
Effective Tax Rates			
Corporate Sector			
Equipment	-.089	.100	.214
Non-residential Structures	.286	.344	.373
Non-residential Land	.525	.506	.486
Inventories	.508	.488	.467
Overall	.366	.387	.398
Noncorporate Sector			
Overall	.334	.332	.326
Owner-Occupied Housing	.233	.225	.217
Overall	.325	.333	.334
Standard Deviation in the Cost of Capital	.0175	.0150	.0133
2. Tax Reform			
Effective Tax Rates			
Corporate Sector			
Equipment	.312	.396	.454
Non-residential Structures	.375	.431	.465
Non-residential Land	.469	.478	.486
Inventories	.448	.458	.466
Overall	.405	.444	.472
Noncorporate Sector			
Overall	.338	.339	.335
Owner-Occupied Housing	.243	.237	.231
Overall	.346	.365	.378
Standard Deviation in the Cost of Capital	.0097	.0114	.0135[b]

Source: Authors' calculations as described in the text.

[a] Calculations assume s=0.05 and individual arbitrage.

[b] At 8 percent inflation, the standard deviation is greater for tax reform than for prior law. This does not mean, however, that tax reform worsens neutrality. A better measurement of dispersion might be the coefficient of variation, which equals the standard deviation divided by the mean. (Neither is a perfectly correct measure of neutrality.) The coefficient of variation for prior law (at 8 percent inflation) is .0398. Tax reform (at 8 percent inflation) lowers this to .0357. Thus, tax reform may still improve neutrality. At some higher inflation rate, however, assets may be taxed more uniformly under prior law than tax reform.

benefit of nominal interest deductions. Overall, effective tax rates in the corporate sector slightly increase with inflation, rising from 36.6 percent when there is no inflation to 39.8 percent at an inflation rate of 8 percent. Because of the relative importance of non-depreciable land, the overall average effective tax rate in the noncorporate sector falls as inflation rises. The effective rate on owner-occupied housing falls slightly as inflation rises, due to the increasing subsidy on debt.

Under prior law the overall economy wide average effective tax rate rises slightly (by 2.8 percent) as inflation increases from 0 percent to 8 percent. Thus, the effects due to unindexed cost recovery allowances and the taxation of purely nominal corporate profits outweigh the benefit arising from the subsidy to debt. This result is similar to that obtained by Feldstein and Summers (1979), and in contrast to that obtained by Fullerton (1987), who uses a similar model. In our model, (and in Fullerton's) the influence of inflation on the overall effective tax rate depends on such parameters as personal tax rates and capital stock weights. It also depends on the arbitrage assumption. Indeed, this is an important factor explaining the difference between our result and Fullerton's. When our analysis is redone using the firm arbitrage assumption of Fullerton (1987), we also find that prior law effective tax rates fall slightly with inflation. This ambiguity aside, it is clear that inflation can cause arbitrary unintended changes in effective tax rates across assets and sectors. Thus, to the extent that effective tax rates at some target rate of inflation reflect tax policy, an unindexed tax system will not fulfill Congress' intent if inflation changes unexpectedly.

Panel 2 of Table 5.12 shows how effective tax rates under tax reform respond to changes in inflation. Because tax reform increases the tax rate on capital gains and reduces the subsidy to debt, the taxation of inflationary capital gains is more important than the deduction of inflationary interest payments in the corporate sector. Thus, in contrast with prior law, corporate sector effective tax rates on nondepreciable assets rise with inflation. For the same reason, as well as the erosion of depreciation allowances defined in nominal terms, effective tax rates on depreciable assets continue to rise with inflation. Thus, the effective tax rate on all corporate assets rises with inflation, so the overall average effective rate in the corporate sector rises with inflation under tax reform.

The overall average effective tax rate in the noncorporate sector, as well as the effective rate on owner-occupied housing, falls as inflation rises from zero to an 8 percent rate. As under prior law. this reflects the rising benefits of subsidized interest payments in the noncorporate and owner-occupied housing sectors. The overall average effective tax rate for the entire economy, however, rises by 3.2 percentage points (9.2 percent) as inflation increases from 0 to 8 percent. This increase is sharper than that obtained under prior law (as is the rise in the overall average rate in the corporate sector), and the difference is due to the higher tax rate imposed on purely nominal capital gains, the reduced subsidy to debt, and the slower cost recovery provisions of the Tax Reform Act of 1986.

B. Indexation of Depreciation and Capital Gains for the Effects of Inflation

Our analysis above shows that effective tax rates are sensitive to inflation. Of particular concern to many policy analysts is the erosion in the value of depreciation allowances due to inflation. Indeed, the original Treasury proposal for tax reform, the President's proposal, and the House Bill all would have provided some indexation of depreciation allowances for inflation.

The first panel of Table 5.13 shows effective tax rates when depreciation allowances are fully indexed for inflation. Comparing these rates with those

Table 5.13 **Indexation and Effective Tax Rates***

Inflation Rate	0%	4%	8%
1. Tax Reform with Indexed Depreciation Allowances			
Effective Tax Rates			
Corporate Sector			
Equipment	.312	.323	.335
Non-residential Structures	.375	.385	.395
Non-residential Land	.496	.478	.486
Inventories	.448	.458	.466
Overall	.405	.415	.424
Noncorporate Sector			
Overall	.338	.325	.311
Owner-Occupied Housing	.243	.237	.231
Overall	.346	.346	.345
Standard Deviation in the Cost of Capital	.0097	.0104	.0112
2. Tax Reform with Indexed Depreciation Allowances and Indexed Capital Gains			
Effective Tax Rates			
Corporate Sector			
Equipment	.312	.278	.241
Non-residential Structures	.375	.344	.311
Non-residential Land	.469	.445	.418
Inventories	.448	.422	.393
Overall	.405	.377	.345
Noncorporate Sector			
Overall	.338	.325	.311
Owner-Occupied Housing	.243	.237	.231
Overall	.346	.327	.307
Standard Deviation in the Cost of Capital	.0097	.0086	.0076

Source: Authors' calculations as described in the text.

*Calculations assume s=0.05 and individual arbitrage.

for unindexed tax reform in panel 2 of Table 5.12 shows that indexing depreciation allowances sharply reduces effective tax rates on depreciable property, and makes these rates less sensitive to inflation. Consequently, the overall average effective tax rate in the corporate sector is lower and rises less sharply with inflation than when depreciation is not indexed. In the noncorporate sector, the overall average rate is lower and falls more rapidly than when allowances are not indexed (with indexation there is no offset to the rising subsidy on debt). Overall, with depreciation indexation the economy wide average effective tax rate is almost constant as inflation varies from 0 percent to 8 percent, in contrast to a 3.2 percentage point increase when depreciation allowances are not indexed for inflation.

If we compare these effective tax rates for tax reform plus indexed depreciation with those for (unindexed) prior law in panel 1 of Table 5.12, we see that tax reform would have caused a much smaller increase in effective tax rates on depreciable property, as well as in the overall average effective tax rate for the corporate sector and the economy as a whole, had depreciation been indexed. In the noncorporate sector with depreciation indexing the overall average rate is below its prior law level. Furthermore, for positive inflation rates, the standard deviation in the cost of capital is reduced by indexing depreciation allowances, and neutrality is improved, compared with prior law and (unindexed) tax reform. In part, this is due to a reduction in the differential between tax rates on business investment in depreciable property compared to that on owner-occupied housing.

The 60 percent exclusion of long-term capital gains under prior law has been justified as compensation for the failure to adjust taxable gains for inflation. Tax reform repeals the exclusion, and treats capital gains as ordinary income. This treatment as ordinary income sharply increases the tax rate on accrued gains compared to its prior law level, and is a primary reason for higher corporate and overall economy wide average effective tax rates under tax reform than under prior law. Commentators have suggested that tax reform could be improved upon by indexing capital gains form inflation. Yolanda Henderson[21] has stated that the principal weakness in the Tax Reform Act of 1986 is the failure to index both depreciation and capital gains for the effects of inflation. The second panel of Table 5.13 provides the results of our analysis of this issue.[22]

For positive inflation rates, indexing both capital gains and depreciation allowances further reduces corporate sector effective tax rates. With both depreciation and capital gains indexing the overall average effective tax rate in the corporate sector, as well as the overall average economy wide effective rate, are below their (unindexed) prior law levels for inflation rates of 4 and 8 percent. Due to a reduction in the effective rates in the corporate sector compared to the already lower rates in the noncorporate and owner-occupied housing sectors, taxation is more uniform with both depreciation and capital gains indexation than for (unindexed) prior law, the actual (unindexed) tax reform act, or tax reform plus depreciation indexing.

Finally, we note that the combined effects of depreciation and capital gains indexing cause effective taxes in the corporate sector to fall with inflation. Indexing removes the effective tax rate increasing influences of the erosion of the value of depreciation allowances and the taxation of purely nominal corporate retained profits, but leaves the tax reducing influence of higher nominal interest deductions. Overall average effective tax rates in all sectors now fall with inflation. Thus, while these indexing provisions reduce effective tax rates and improve neutrality for a given inflation rate, they do not eliminate uncertainty due to unexpected changes in the inflation rate.

VIII. EFFECTS OF ACCOUNTING PROVISIONS ON MEASURED INVESTMENT INCENTIVES

The effective tax rate model we have employed captures the influence of changes in statutory income tax rates, investment tax credits, and depreciation allowances on investment in 51 depreciable and 3 nondepreciable assets in the corporate and noncorporate sectors of 60 different industries, as well on investment in owner-occupied housing. The model, however, is not exhaustive. It has been criticized for omitting the effect of several important business tax provisions which are substantially tightened by tax reform (see, for example, Ballentine (1986)). Thus, the model has been accused of systematically understating the increase in effective tax rates caused by tax reform.

In this section, we present a tentative analysis of the effect on marginal investment incentives of major reforms in accounting rules. We conclude that many "omissions" have no influence on marginal investment incentives of the type measured in this paper. They do not affect taxes paid on income generated by a uniform expansion of the existing capital stock. However, cost capitalization rules for multi-period accounting do affect marginal investment incentives. Our estimates suggest that including these rules causes tax reform to compare somewhat less favorable with current law than when these rules are ignored. For the economy as a whole, however, this effect is small.

First consider installment sales. Rules regarding installment sales are sometimes said to affect marginal investment incentives. In contrast, however, we would argue they have no influence on investment incentives. To take a simple example, a department store under prior law could deduct the cost of a good at the time of sale, even though it included the customer's payments as received over some period of time. This deferral certainly reduced the effective tax paid by the department store, but it was not an incentive to expand inventories or any other real investment. Instead, this provision reduced the effective cost of the good sold and is best modeled as an output subsidy. Under tax reform, income from sales using the installment method must be recognized at the time of sale, rather that deferred as under prior law. Thus, an output or sales subsidy has been reduced. There has been no direct change in the tax treatment of income from investment in real assets.

Second, tax reform also repeals provisions which allowed both financial and nonfinancial firms to accelerate the deduction of losses due to bad debts. This change reduces interest free loans from the government to the taxpayer, thus effecting the matching of income and expense. Again, however, these provisions are not associated with the incentives to make new real investment. For nonfinancial corporations, bad debt reserves are associated with their lending, usually to purchasers, and could thus be modeled as an output tax or subsidy. They are not associated with borrowing to buy new real investment. For financial corporations, bad debt reserves are associated with the provision of their output, financial services, and not with their own real investment (e.g., bank buildings and vaults). The only effect that these provisions might have on the cost of capital for new real investment is an indirect effect through raising the cost of financial services that might be a necessary component of financing and making new real investment. However, this indirect effect requires general equilibrium changes in output prices. (In this case the price of banks' output is the interest rate differential they charge.) Moreover, as noted in Neubig and Sullivan (1987, this volume), banks benefit from rate reduction so the net effect of tax reform on the price of financial services is ambiguous at best. It does not directly affect the tax treatment of income from our marginal real investment, and thus has no direct effect on investment incentives.

Changes in multi-period production accounting rules are projected to raise $35 billion in corporate revenue over the 1987-1991 period. In contrast to other accounting rule changes, these changes can affect investment incentives. This estimate includes some one-time revenue, however, so the effect on marginal investment incentives might be overstated by looking only at revenue estimates. Under the new rules, firms must capitalize into basis certain costs which previously could be expensed, such as some pension costs, accelerated depreciation, and general and administrative costs.

New "uniform" capitalization rules affect investment in inventory and self-constructed real estate. Data from a variety of sources (Commerce, IRS, and industry representatives) suggest that roughly 20 percent of the costs of inventory and self-constructed real estate is expensed under prior law. Revenue estimates suggest that tax reform would reduce this fraction to about 5 percent.

Data from similar sources suggest that in most industries perhaps 20 percent of structures investment is treated as self-constructed for tax purposes. In a few industries, however, such as utilities, casual evidence suggests that as much as 80 percent of structures might be considered self-constructed for tax purposes.

Tighter rules also apply to assets constructed under long-term contract. Prior law allowed use of the completed contract method of accounting for long-term contracts. Under this generous accounting system perhaps 10 percent of costs could be expensed. Tax reform reduces expensible costs to perhaps 3 percent of contract costs. In addition tax reform requires that 40 percent of any long-term contract use the percentage of completion method, which provides proper income tax treatment for all expenditures. We thus assume that tax reform allows expensing of only 2 percent of costs associated with long term contracts.

We divide inventory into two components. The first component is affected by uniform capitalization rules. The second is affected by changes in accounting for long term contracts. Based on data from Standard and Poor's Industry Surveys, Construction Review, the Survey of Current Business, and unpublished Commerce surveys, we estimate that about 10 percent of our stock of inventories might be affected by accounting rules covering long- term contracts. We assume that the remaining 90 percent of inventory is affected by changes in uniform capitalization rules.

Table 5.14 shows how our modeling of multi-period accounting rules affects our results. For comparison purposes, the first two columns reproduce standard results from Table 5.6 for prior law and tax reform. For structures and inventory, expensing is more generous than regular tax treatment, and the next two columns show that our modeling of accounting rules lowers the effective tax rates on structures and inventory, compared to those obtained when these rules are ignored. As a consequence, neutrality is also slightly improved. (Equipment is affected because some real property is included in BEA definitions of equipment.)

Because tax reform tightens multi-period accounting rules, it raises effective tax rates by a slightly larger amount compared to prior law when such rules are modeled than it does when accounting rules are ignored. The overall average rate in the corporate sector rises by 5.7 percentage points (or 14.7 percent) when accounting rules are ignored, compared to a higher 7.7 percentage point (or 21.2 percent) rise when accounting rules are included. For the economy as a whole, with accounting rules the average effective tax rate rises by 4.4 percentage points (13.8 percent), instead of the 3.2 percentage point (9.6 percent) increase estimated when accounting rules are left out of the analysis. Thus, including accounting rules suggests that tax reform will cause a somewhat larger rise in effective tax rates than when these rules are ignored. Nonetheless, even with the accounting rule changes, tax reform encourages a more productive allocation of investment by evening the tax treatment of different investments.

IX. DISCUSSION

The cost of capital model we employ includes the effects of personal and corporate tax rates, ITCs, depreciation allowances, and multi-period accounting rules on investment incentives for a large number of depreciable assets, as well as land and inventories. Our modeling of depreciation allowances is more complete than elsewhere in the literature. However, further development

Table 5.14 **Accounting Rules for Multi-period Production***

	Without Accounting Rules		With Accounting Rules	
	Prior Law	Tax Reform	Prior Law	Tax Reform
Corporate Tax Rates				
Equipment	.100	.396	.095	.395
Structures				
Non-residential	.344	.431	.337	.430
Residential	.495	.525	.488	.524
Public Utility	.326	.445	.310	.442
Inventories	.488	.458	.440	.449
Land				
Non-residential	.506	.478	.506	.478
Residential	.539	.514	.539	.514
Overall	.387	.444	.363	.440
Noncorporate Tax Rates				
Equipment	-.119	.254	-.120	.254
Structures				
Non-residential	.278	.314	.273	.312
Residential	.382	.406	.377	.404
Public Utility	.221	.336	.217	.334
Inventories	.330	.305	.294	.297
Land				
Non-residential	.361	.338	.361	.338
Residential	.414	.395	.414	.395
Overall	.332	.339	.327	.337
Owner-Occupied Housing Tax Rate	.225	.237	.225	.237
Overall Tax Rate	.333	.365	.319	.363
Standard Deviation of Cost of Capital	.0150	.0114	.0135	.0111

Source: Authors' calculations as described in the text.

*Calculations assume $s=0.05$, $\pi=0.04$.

is possible. For example, we do not include the effect of the special treatment of farm structures and certain expensible assets used in mineral production. It would also be possible to include a more complete modeling of financial institutions. Furthermore, other statutory provisions, such as the treatment of pollution control equipment, are ignored. Finally, we do not attempt to model passive loss rules, the alternative minimum tax, or the tax treatment of research and development.

In addition, there are problems with the basic model itself. For example, it may be inappropriate to ignore risk, as we do in this perfect certainty model. In addition, it might be said that there are inherent inconsistencies in our modeling. Firms are assumed to minimize taxes by using the most generous depreciation allowances and LIFO inventory accounting. However, they use both debt and equity financing when debt is always cheaper. These issues await further analysis, but they imply that the numerical results in this paper need to be interpreted in the context of the type of model used to generate them.

Overall, our results suggest that tax reform will cause a slight increase in effective tax rates. However, due in large part to ITC repeal and corporate rate reduction, the relative tax treatment of different assets and investors is improved. Thus, a more efficient allocation of investment is likely to result.

FOOTNOTES

[1] Accounting rules are considered in Section VIII below. The model ignores changes in the minimum tax, passive loss rules, and the treatment of research and development.

[2] See Fullerton (1987) for more on firm arbitrage.

[3] For a variety of reasons not captured here, firms may not always minimize their taxes by taking the earliest possible deductions. In order to concentrate on the tax wedge and to insure comparability across tax regimes, however, calculations here assume tax minimizing behavior, including use of LIFO methods for inventory accounting.

[4] This is especially true for calculations based on the assumption of firms arbitrage. With that arbitrage assumption, personal taxes are not fully reflected in the cost of capital, but are fully reflected in the effective tax rate.

[5] Gravelle (1982) assumes that all is by corporations, and Auerbach (1983b) explicitly considers only the corporate sector.

[6] The algorithm also allows for the classification of assets, especially real property, which do not have ADR midpoint lifetimes.

[7] The capital stocks are computed using the perpetual inventory method.

[8] These nonneutralities are due to deviations of total cost recovery allowances from economic depreciation. Thus, the ITC also contributes to these inefficiencies.

[9] Certain industry specific features of the tax code are not accounted for in our modeling. For example, we ignore the special tax treatment of farm structures and petroleum mining shafts and wells.

[10] The International Trade Commission's study also differs from ours by using investment flows rather than (the more appropriate) capital stocks as weights in aggregating up to industry and sectoral levels.

[11] We do not consider any induced change in income tax rates at the state level. Thus, to the extent that states lower their statutory income tax rates in response to federal base broadening, our estimates overstate effective tax rates under tax reform.

[12] See Cilke and Wyscarver (1987, this volume) for more detail on this model.

[13] Fullerton, Henderson, and Mackie (1987, this volume) also provide a detailed description of these adjustments.

[14] For debt financed investment, corporate rate reduction can increase the cost of capital and effective tax rate, as discussed below.

[15] The standard deviation in the cost of capital is not a perfect measure to use in comparing dispersion across tax regimes. It does not adjust for differences in scale, as for example, the coefficient of variation does. In addition, it does not measure the welfare cost due to nonneutralities. Nonetheless, for the results in our paper, a lower standard deviation is associated with a lower coefficient of variation (except in one case that is noted) so the standard deviation provides relevant information on dispersion.

[16] An interesting side point illustrated by Table 5.8 is that for prior law it is the ITC, as opposed to accelerated depreciation, which gives a tax advantage to investment in equipment relative to nonresidential structures. Without the ITC, the effective tax rate on equipment is

larger than the effective tax rate on nonresidential structures. However, comparing our results to those in Fullerton (1987) suggests that this conclusion might depend on arbitrage assumptions.

[17] For corporate investment financed entirely through new share issues, tax reform reduces the overall average effective tax rate in the corporate sector from 67 percent to 61 percent. If corporate equity is obtained equally from new share issues and retained earnings, and one-third of all investment is debt financed, then the overall average effective tax rate on investment in the corporate sector rises only modestly from 47.4 percent under prior law to 47.9 percent under tax reform (see Table 5.11 below).

[18] This is also true for some unenacted proposals. For example, Fullerton (1987) finds that, compared with prior law, the President's proposal would reduce the overall average effective tax rate in the corporate sector under individual arbitrage, but increase it under firm arbitrage.

[19] The new view received empirical support in Auerbach (1984), but the old view was found more compatible with historical evidence in Poterba and Summers (1983, 1985).

[20] In equation (5.2), under the old view c_d is .333, c_{re} is .333, and c_{ns} is .333.

[21] See Brookes (1986) as well as Henderson (1986).

[22] See Fullerton (1987) for the modeling of the indexation of capital gains.

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6 INVESTMENT ALLOCATION AND GROWTH UNDER THE TAX REFORM ACT OF 1986

Don Fullerton, Yolanda K. Henderson, and James Mackie

I. INTRODUCTION

Investment incentives and economic efficiency have been important issues in the debate preceding passage of the Tax Reform Act of 1986. The final version of tax reform changes the taxation of capital, and hence investment incentives, in several important ways. Cost recovery allowances are tightened as a result of longer lives for depreciation and repeal of the investment tax credit. At the same time, however, the corporate statutory rate has fallen from 46 percent to 34 percent. In addition, tax reform lowers individual tax rates on interest, dividends, and noncorporate income, but raises the rate on capital gains.

The paper by Fullerton, Gillette, and Mackie (1987, this volume) analyzes the effect of tax reform on investment incentives. Their cost of capital analysis suggests that overall investment and savings incentives might be reduced by tax reform. Thus tax reform could reduce capital formation and growth. At the same time, however, they point out that tax reform will improve the allocation of a given stock of capital. Thus, the net welfare effect of the capital taxation provisions of the Tax Reform Act of 1986 is ambiguous. It depends on the sensitivity of total investment to the overall net rate of return, as compared to the sensitivity of capital allocation to differential returns across assets. Analysis of the cost of capital by itself can only point out incentives for behavioral changes. It cannot assess the magnitudes of such changes.

Fullerton and Henderson (1986a) have developed a general equilibrium model that can analyze the effects of changes in investment incentives on savings, investment, allocation, output, and welfare. Their model incorporates the cost of capital model of Fullerton and Henderson (1984) into the general equilibrium model developed by Fullerton, Shoven, and Whalley (1978, 1983).

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As a consequence, the Fullerton-Henderson general equilibrium model facilitates analysis of the tax-induced welfare effects of changes in interasset, intersectoral, and intertemporal distortions of the type associated with tax reform.

Fullerton and Henderson (1986b) have used their disaggregate general equilibrium model to evaluate the capital taxation provisions of the Treasury proposal of 1984 and the President's proposal of 1985. We use this model to analyze the Tax Reform Act of 1986. We find that tax reform improves welfare under a wide variety of assumptions concerning the relative importance of interasset, intersectoral, and intertemporal effects. Thus, the reform-induced reduction of interasset distortions generally offsets the effects of increases in intersectoral and intertemporal distortions. Only when saving is very sensitive to the net rate of return, or when investment allocation is very insensitive to differential asset taxation, does tax reform fail to stimulate improvements in output and welfare.

The paper is organized as follows. In section I we measure the impact of tax reform on investment incentives using a cost of capital model. In section II we describe the general equilibrium model of Fullerton and Henderson in more detail. Section III presents our simulation results. We conclude in section IV with a summary of our findings.

II. THE EFFECT OF TAX LAW ON INCENTIVES

The Tax Reform Act of 1986 incorporates pervasive changes to the tax code, but this paper concentrates on provisions that would affect taxes on income from capital. These include the reduction of the top corporate rate from 46 to 34 percent and the reduction of personal rates to two brackets of 15 and 28 percent[1], as well as revised capital cost recovery provisions, including the repeal of the investment tax credit.

This section measures the investment incentives arising from these changes and compares them to incentives under prior law. The model of investment incentives is based on Fullerton and Henderson (1984), as updated in Henderson (1986) and Fullerton (1987). In order to use these costs of capital as inputs for the general equilibrium model, we omit the further disaggregation of capital stocks and other refinements of Fullerton, Gillette, and Mackie (1987, this volume).

A. A Model of Investment Incentives

We measure investment incentives using the cost of capital approach of Hall and Jorgensen (1967). Consider a perfectly competitive corporate firm contemplating a new investment in a world with no uncertainty. Assume the firm has sufficient tax liability to take associated credits and deductions, and that it does not resell the asset.[2] Investment receives a tax credit at rate k. The rental return increases at the constant inflation rate π, and decreases because of constant exponential depreciation of the asset at rate δ. Local property tax at rate w is paid on the asset's value at any point in time, and the return net of property tax is subject to the corporate income tax at statutory rate u. These net returns are discounted at the firm's nominal after-tax discount rate r. The present value of depreciation allowances per dollar of marginal investment is z.[3] In equilibrium, the real social return in the corporate sector, gross of tax but net of depreciation, ρ^c, may be written as:

$$\rho^c = \frac{r-\pi+\delta}{1-u}(1-k-uz) + w - \delta \,. \tag{6.1}$$

In calculations below, common values are used for r, π, and u, but each asset has a specific value for δ, k, z, and w. Similar expressions may be derived for the real social return in the noncorporate business sector and owner-occupied housing sector. See Fullerton, Gillette, and Mackie (1987, this volume).[4]

To compute the discount rate, we assume that individuals hold debt and equity issued by all three sectors, and that they arbitrage away any differences in net rates of return.[5] Suppose i is the nominal interest rate and τ_d is the debtholder's personal marginal tax rate. Then, under our arbitrage assumption, all assets must provide the real net return that individuals could earn on their debt holdings:

$$s = i(1-\tau_d)-\pi \,. \tag{6.2}$$

Here, s represents the net-of-all-tax return in the corporate, noncorporate, and owner-occupied housing sectors. In our computations, we start with an assumption on s and use equation (6.2) to calculate i for all sectors as $(s+\pi)/(1-\tau_d)$.

The computation of discount rates then involves examining separately each sector and source of finance–debt, retained earnings, and new share issues–assuming that the financial decision is exogenous. We focus our discussion on the corporate sector, but similar expressions are derived for the noncorporate business and owner-occupied housing sectors. The corporation's discount rate for debt is simply the rate of return net of corporate income tax: $r = i(1-u)$. For retained earnings, the individual's nominal net return must match $i(1-\tau_d)$. The investment earns a nominal net-of-corporate-tax return r and the resulting share appreciation is taxed at the accrued personal capital gains rate τ_{re}. The return r must be such that $r(1-\tau_{re}) = i(1-\tau_d)$. The solution for r provides the requisite discount rate. Finally, new shares provide a return net of corporate taxes that can be paid as dividends and taxed at personal rate τ_{ns}, so $r(1-\tau_{ns}) = i(1-\tau_d)$. The corporation's single discount rate is a weighted average of these three discount rates:

$$c_d\left[i(1-u)\right] + c_{re}\left[\frac{i(1-\tau_d)}{(1-\tau_{re})}\right] + c_{ns}\left[\frac{i(1-\tau_d)}{(1-\tau_{ns})}\right] \tag{6.3}$$

where c_d, c_{re}, and c_{ns} are the proportions of new investment financed by debt, retained earnings, and new shares, respectively.[6]

Investment incentives are properly measured by the marginal product of capital, ρ, but we present many of our results in terms of marginal effective total tax rates. These tax rates (t) are the difference between the pre- and post-tax rates of return, as a proportion of the pre-tax rate of return. Because s is the return net of all taxes, this effective rate reflects the combined impact of corporate taxes, property taxes, and personal taxes. It shows the portion of capital costs attributable to taxes.[7] The reason for looking at effective tax rates is that they are easily interpreted. For example, the effective rate can be compared with the statutory corporate rate, or with the zero rate that would apply in the case of a consumption tax. With s constant throughout the economy, t varies with ρ in such a way that assets, industries, or sectors with higher effective tax rates also face higher required pre-tax rates of return for investment.

B. The Two Tax Regimes

The above framework is useful to sort out the net impact of statutory tax rates, cost recovery provisions, and other rules affecting interest, dividends, and capital gains. This section proceeds to discuss values for the parameters necessary to implement that framework, for prior law and for the Tax Reform Act of 1986.

1. Statutory tax rates

For prior law, we use the top federal statutory rate of .46 for marginal corporate income. The weighted average of states' top-bracket rates has been estimated to be .0655 by King and Fullerton (1984, p. 204). Accounting for the deductibility of state taxes at the federal level, the appropriate value for u is .46+.0655(1-.46), which equals 49.5 percent. Tax reform sets a top federal rate of .34 and maintains the deductibility of state corporate taxes. For this reform, u is thus 38.3 percent.

We also require marginal tax rates at the personal level. To measure corporate investment incentives, we need marginal rates on dividend income (τ_{ns}) and capital gains (τ_{re}). For noncorporate business, we require a marginal rate on entrepreneurial income (τ_{nc}), which enters the noncorporate cost of capital in a manner analogous to the effect of u on the corporate cost of capital. Similarly, we require a rate for interest and property tax deductions of home-owners (τ_h) in order to measure incentives for investment in owner-occupied housing. Finally, to include the effect of debt finance, we need a marginal tax rate for interest income (τ_d).

The marginal investment under consideration is an equiproportionate increase in all capital stocks, with an equiproportionate increase in the holdings of all investors. Additional debt and interest income, for example, would be distributed among debtholders in proportion to their current debt and interest income. The appropriate marginal tax rate is thus the average of all debtholders' marginal rates, weighted by their interest income. We include both federal and state taxes. Furthermore, these rates must reflect the proportions of income received directly by households and the proportions received indirectly through institutions such as nonprofit organizations and life insurance companies.

For households, federal tax rates were calculated by James Cilke using the Treasury Individual Tax Model.[8] The computed rate for housing interest deductions under prior law is 20.9 percent. The rate for interest recipients (25.5 percent) and rate for dividend recipients (32.9 percent) indicate that they are on average in higher brackets than homeowners. The 41.0 percent capital gains rate reflects the full taxation of realized gains, and the 25.0 percent noncorporate rate reflects the low brackets of many proprietors and partners with losses for tax purposes. All of these personal tax rates would be reduced by tax reform. The newly calculated marginal rates are: housing deductions, 17.5 percent; interest received, 21.6 percent; dividends, 25.8 percent; capital gains, 26.7 percent; and noncorporate income, 21.0 percent.

In order to include state income taxes, 5 percentage points are added to each of these federal rates.[9] This percentage reflects the weighted average of the different states' rates, and the deductibility of state taxes at the federal level for those who itemize.

The personal rate on interest is then adjusted to account for the taxation of banks, as described in King and Fullerton (1984, pages 223-226). The resulting rate for households must then be averaged with a zero rate for the interest income of nonprofit institutions, and another rate for the interest income of life insurance companies.[10] The final estimate for τ_d, as shown in Table 6.1, is 21.9 percent for prior law and 19.4 percent for tax reform.

Table 6.1 **Tax Rate Parameters**

Type of Income	Prior Law	Tax Reform Act of 1986
Interest Received	.219	.194
Dividends Received	.285	.232
Capital Gains	.074	.125
Noncorporate Income	.300	.260
Housing Deductions	.259	.225

The household rate on dividends is similarly raised to account for state taxes and reduced to account for the dividends received by tax-exempt institutions and insurance companies.[11] The resulting value for τ_{ns} is .285 under current law and .232 under tax reform. The noncorporate rate is raised by state taxes, but not reduced by any holdings of institutions. It is .300 and .260 under prior law and tax reform, respectively.

Under prior law, only 40 percent of realized long term capital gains were subject to federal income taxation. Adding 5 percent to account for state taxes, and adjusting for exclusion brings the rate down to 18.4 percent. The advantage of deferral cuts the effective rate of tax approximately by half.[12] Taking into account insurance companies (taxed at a 28 percent rate) and tax exempts yields an effective rate on accrued capital gains of 7.4 percent. Tax reform eliminates the 60 percent exclusion on long term capital gains. Thus, we do not reduce the 26.7 percent rate to account for special treatment of capital gains income. However, we do account for state taxes, tax exempts, insurance companies, and deferral. Under tax reform, our overall effective rate on accrued capital gains is 12.5 percent.

The prior law weighted-average rate for mortgage interest deductions (τ_h) is raised to .259 to account for state taxes. Tax reform lowers this rate to .225. In measuring incentives to invest in owner-occupied housing, we recognize that only a fraction of homeowners take advantage of the deductibility of property taxes by itemizing their deductions. The Treasury Individual Tax model indicates that only 48 percent of household real property taxes were deducted by itemizers ($\lambda = .48$). Tax reform would reduce this fraction to 41 percent.

2. Capital cost recovery

Potential for nonneutralities arises because different assets depreciate at many different rates, while tax codes tend to simplify by grouping assets into a few categories for depreciation allowances. In order to capture these nonneutralities, it is important to include many diverse assets in the model. Table 6.2 lists the 35 depreciable assets used in this study, including 20 kinds of equipment and 15 types of structures. The economic depreciation rates δ are estimated by Hulten and Wykoff (1981) and shown in the first column of Table 6.2. These range from a high of .333 for autos to a low of .015 for residential buildings. We also include inventories and land in our study. These are assumed not to depreciate, and they do not receive any depreciation allowances.

The second column of Table 6.2 shows the recovery periods available under the Accelerated Cost Recovery System (ACRS) of prior law. Autos are depreciated over 3 years, other equipment over 5 years, public utility structures over 10 or 15 years, and other structures over 19 years. Allowances over these lifetimes can be read from tables in the law. In effect, equipment and public utilities receive allowances based on 150 percent of declining balance

Table 6.2 **Tax Parameters for Each Asset**

		Economic Depreciation Rate[a]	Recovery Period		Prior Law Investment Tax Credit
			Prior Law (ACRS)	Tax Reform Act of 1986	
1	Furniture and Fixtures	.110	5	7	.10
2	Fabricated Metal Products	.092	5	7	.10
3	Engines and Turbines	.079	5	7	.10
4	Tractors	.163	5	5	.10
5	Agricultural Machinery	.097	5	7	.10
6	Construction Machinery	.172	5	7	.10
7	Mining and Oil Field Machinery	.165	5	5	.10
8	Metalworking Machinery	.123	5	7	.10
9	Special Industry Machinery	.103	5	7	.10
10	General Industrial Equipment	.123	5	7	.10
11	Office and Computing Machinery	.273	5	7	.10
12	Service Industry Machinery	.165	5	7	.10
13	Electrical Machinery	.118	5	7	.10
14	Trucks, Buses, and Trailers	.254	5	5	.10
15	Autos	.333	3	5	.06
16	Aircraft	.183	5	5	.10
17	Ships and Boats	.075	5	10	.10
18	Railroad Equipment	.066	5	7	.10
19	Instruments	.150	5	7	.10
20	Other Equipment	.150	5	7	.10
21	Industrial Buildings	.036	19	31.5	.00
22	Commercial Buildings	.025	19	31.5	.00
23	Religious Buildings	.019	19	31.5	.00
24	Educational Buildings	.019	19	31.5	.00
25	Hospital Buildings	.023	19	31.5	.00
26	Other Nonfarm Buildings	.045	19	31.5	.00
27	Railroads	.018	15	20.0	.10
28	Telephone and Telegraph	.033	15	20.0	.10
29	Electrical Light and Power	.030	15	20.0	.10
30	Gas Facilities	.030	10	15.0	.10
31	Other Public Utilities	.045	10	15.0	.10
32	Farm Structures	.024	19	20.0	.00
33	Mining, Shafts and Wells	.056	5	5.0	.00
34	Other Nonbuilding Facilities	.029	19	31.5	.00
35	Residential Structures	.015	19	27.5	.00

*Economic depreciation rates come from Hulten and Wykoff (1981) and Jorgenson and Sullivan (1981).

with a switch at the optimal time to straight line. The depreciation basis is reduced by half the investment tax credit. Other structures receive allowances based on 175 percent of declining balance with an optimal switch to straight line.

At zero inflation, these allowances are high relative to economic depreciation. They are fixed in nominal terms, however, so that at moderate inflation rates, their real present value may be less than that of economic depreciation. We use a nominal discount rate in calculating z to account for the fact that allowances are based on historical cost. The exact formula is shown in King and Fullerton (1984, page 211).

Tax reform modifies depreciation allowances in several important ways. It expands the number of recovery classes from 5 to 8, and it generally lengthens recovery periods. Personal property is now depreciated over periods ranging from 3 to 20 years. In the 3, 5, 7, or 10 year class, personal property receives allowances based on 200 percent declining balance with an optimal switch to straight line. Personal property in the 15 and 20 year class receives 150 percent declining balance. Real nonresidential property is depreciated over a 31.5 year period, and residential real property is depreciated over a 27.5 year period, both based on the straight line method. Tax reform recovery periods for each of our 35 types of depreciable property are shown in the third column of Table 6.2.

The other aspect of capital cost recovery is the investment tax credit. Current law provides a 6 percent credit for automobiles, a 10 percent credit for other equipment, a 10 percent credit for public utility structures, and no credit for buildings. These rates are shown in the fourth column of Table 6.2. The Tax Reform Act of 1986 repeals these credits.

3. Other parameters

For local property tax rates (w), we use the same parameters under both tax regimes. Assuming that new investments will pay the same property tax on average as existing investments, data in Fullerton and Henderson (1984) indicate rates of .00768 for equipment and inventories, .01126 for business land and structures, .01550 for public utilities, and .01837 for residential land and structures.

We assume that marginal investments in all three sectors are financed using one-third debt and two-thirds equity (Fullerton and Henderson, 1984). However, we consider two alternative assumptions for the division of corporate equity between retained earnings and new share issues.

One scenario is based on the financing of existing corporate capital. Under this first scenario, we follow King and Fullerton (1984) in assuming that our marginal corporate investment is financed 61 percent through retentions, 34 percent through debt, and 5 percent through new share issues. This assumption is important because equation (6.3) indicates that the dividend tax (reduced by tax reform) affects investment financed through new share issues, while the capital gains tax (increased by tax reform) is relevant for investment financed by retained earnings.[13] The small 5 percent weight on new share issues in this scenario is thus consistent with the "new view" of dividend taxation (Auerbach, 1979, Bradford, 1981, and King, 1977) which holds that the taxation of dividends does not provide a serious disincentive to marginal investment in the corporate sector.

A competing tradition, however, is the "old view" which holds that dividend payout rates affect the cost of capital, and that there is significant double taxation of corporations because profits are taxed once at the firm level and again when distributed as dividends (McLure, 1979). Under this alternative theory, the reduction in the taxation of dividends would tend significantly to lower the effective tax rate for corporate investments, because firms are observed to distribute a sizable fraction of their earnings to shareholders.[14]

Thus for our second financing assumption, we construct a scenario that is consistent with the findings under the old view, for a payout rate of 50 percent. Although existing investments are financed 61 percent by retained earnings, it may not be possible as easily to finance additional new investments from that same source. If corporations have a limited supply of retained earnings and must increase their reliance on new shares to finance marginal investments, then equation (6.3) may be modified such that equity finance is divided evenly between retained earnings and new shares ($c_{re} = .3315$ and $c_{ns} = .3315$, with c_d still equal to .337). Under this alternative, the dividend tax reduction has a more substantial impact, and the capital gains tax increase has a less substantial impact.

Finally, we set both the inflation rate, π, and the baseline net-of-all-tax rate of return, s, to 4 percent. Solving equation (6.2) with these assumptions and $\tau_d = .219$, we find that i for prior law equals 10.2 percent. If s did not change under the Tax Reform Act of 1986, i would be 9.9 percent. The general equilibrium model below allows endogenous determination of the net rate of return s, but the next subsection first looks at incentives with a fixed net rate of return.

C. Effective Tax Rate Results

This section first concentrates on incentives to invest in different assets. These detailed results are reported only for the "new view" financing assumptions because similar results are obtained for the old view. We next aggregate assets to reflect investment incentives at the sector and industry levels. These aggregate incentives are reported for both the new and old views of dividend taxation.

Table 6.3 shows the present value of depreciation allowances and marginal effective total tax rates for 36 assets in the corporate sector based on new view financing assumptions.[15] Under prior law, the first 20 types of equipment have very low tax rates or could even be subsidized. These effective tax rates range from 0 percent to +6 percent, despite the fact that we are including taxation at both the personal and corporate levels.[16] Equipment has these low effective tax rates because of investment tax credits and because of depreciation allowances in excess of economic depreciation. Structures (assets 21-26, 32-34) face considerably higher tax rates, between 33 and 50 percent, because they are not eligible for the investment tax credit and because of their less generous depreciation allowances. Public utility

Table 6.3 Investment Incentives for Each Asset in the Corporate Sector*

		Present Value of Allowances (z)		Marginal Effective Total Tax Rate	
		Prior Law	Tax Reform Act of 1986	Prior Law	Tax Reform Act of 1986
1	Furniture and Fixtures	.810	.816	.045	.402
2	Fabricated Metal Products		.816	.050	.383
3	Engines and Turbines		.816	.054	.368
4	Tractors		.866	.031	.400
5	Agricultural Machinery		.816	.049	.389
6	Construction Machinery		.816	.028	.460
7	Mining and Oil Field Machinery		.866	.030	.401
8	Metalworking Machinery		.816	.042	.415
9	Special Industry Machinery		.816	.047	.395
10	General Industrial Equipment		.816	.042	.415
11	Office and Computing Machinery		.816	-.001	.532
12	Service Industry Machinery		.816	.030	.454
13	Electrical Machinery		.816	.043	.410
14	Trucks, Buses, and Trailers	↓	.866	.004	.460
15	Autos	.888	.866	.010	.505
16	Aircraft	.810	.866	.025	.414
17	Ships and Boats		.749	.055	.410
18	Railroad Equipment		.816	.057	.354
19	Instruments		.816	.034	.441
20	Other Equipment	↓	.816	.034	.441
21	Industrial Buildings	.589	.369	.476	.523
22	Commercial Buildings			.442	.496
23	Religious Buildings			.423	.481
24	Educational Buildings			.423	.481
25	Hospital Buildings			.438	.492
26	Other Nonfarm Buildings	↓	↓	.500	.543
27	Railroads	.602	.529	.353	.465
28	Telephone and Telegraph		.529	.383	.496
29	Electric Light and Power	↓	.529	.377	.490
30	Gas Facilities	.696	.609	.311	.465
31	Other Public Utilities	↓	.609	.328	.490
32	Farm Structures	.589	.529	.439	.447
33	Mining, Shafts and Wells	.863	.840	.329	.364
34	Other Nonbuilding Facilities	.589	.366	.455	.506
35	Inventories	—	—	.493	.471
36	Land	—	—	.515	.495

*Calculations use "new-view" financing assumptions (with 4 percent inflation and a 4 percent net rate of return).

structures (assets 27-31) have tax rates that are not quite as high as those for most other structures, since they receive a 10 percent investment tax credit. Land and inventories receive neither credits nor accelerated depreciation allowances. Consequently, they face relatively high effective tax rates of 52 and 49 percent, respectively.

Tax reform reduces disparities in tax rates among assets, mostly as a result of rescinding the investment tax credit for equipment and public utility property. Effective tax rates for assets used in the corporate sector lie between 35 and 54 percent. The generally higher level of these rates is due in part to the changes in capital cost recovery provisions, but also to changes in the treatment of interest and capital gains. Currently, investments financed by debt are subsidized in that interest payments are deducted by corporations at a 49.5 percent rate, but included in taxable income of debtholders at an average marginal rate of only 21.9 percent. The difference between 49.5 percent and 21.9 percent is a 27.6 percentage-point subsidy. This subsidy is lowered by the Tax Reform Act to 18.9 percentage points, since interest deductions are made at a 38.3 percent rate while interest income is taxed at a 19.4 percent rate. Effective tax rates in the corporate sector also rise because capital gains on corporate retentions are taxed as ordinary income, thus raising the effective rate on accrued gains from 7.4 percent to 12.5 percent.

Table 6.4 presents user costs and effective tax rates under the new view for the corporate, noncorporate, and owner-occupied housing sectors. Summary measures of investment incentives also are presented for several aggregated assets: equipment, residential and nonresidential structures, public utility structures, inventories, and residential and nonresidential land. Investment incentives for each asset were aggregated using estimates of the 1984 stock of each asset in each sector.[17]

Under prior law, accelerated cost recovery provisions combine with nominal interest deductions to generate a total tax rate in the corporate sector that is below the statutory corporate rate. The overall effective tax rate in the corporate sector is 38.8 percent, only 3.6 percentage points higher than the 35.2 percent effective rate in the noncorporate sector, but 12 points higher than the 26.9 percent rate on owner-occupied housing (attributable to local property taxes). Tax reform actually increases the spread between the overall tax rate in the corporate sector and the overall rates in the other sectors. Less generous capital cost recovery and capital gains provisions overcome the effect of rate reduction to raise the rate in the corporate sector by 7.6 percentage points. The effect of less generous cost recovery provisions is offset to a large degree in the noncorporate sector by the 4 percentage point reduction in the tax rate of proprietors and partners. For housing, the effective tax rate rises slightly. reflecting reduced numbers of itemizers as well as reduced personal rates for interest deductions. Table 6.4 also indicates that tax reform would cut the capital-weighted standard deviation of all of these costs of capital, from .012 to .009.

Table 6.4 **Investment Incentives With New View of Dividend Taxes**

	Prior Law		Tax Reform Act of 1986	
	ρ	t	ρ	t
Corporate Sector				
Equipment	.042	.038	.069	.422
Nonresidential Structures	.072	.441	.078	.489
Public Utility Structures	.063	.361	.078	.484
Inventories	.079	.493	.076	.471
Land	.083	.515	.079	.495
Total	.065	.388	.075	.464
Noncorporate Business Sector				
Equipment	.033	-.201	.056	.289
Nonresidential Structures	.059	.323	.061	.348
Public Utility Structures	.054	.260	.064	.373
Residential Structures	.065	.383	.067	.401
Inventories	.061	.343	.059	.319
Nonresidential Land	.064	.379	.062	.358
Residential Land	.072	.441	.069	.424
Total	.062	.352	.063	.360
Owner-Occupied Housing	.055	.269	.056	.281
Average Overall Cost of Capital	.061		.065	
Standard Deviation	.012		.009	
Average Overall Tax Rate	.347		.387	
Interest Rate	.102		.099	

Table 6.5 **Investment Incentives With Old View of Dividend Taxes**

	Prior Law		Tax Reform Act of 1986	
	ρ	t	ρ	t
Corporate Sector				
Equipment	.051	.212	.074	.459
Nonresidential Structures	.083	.518	.084	.522
Public Utility Structures	.073	.449	.083	.516
Inventories	.093	.571	.081	.509
Land	.097	.587	.085	.529
Total	.077	.482	.080	.500
Noncorporate Business Sector*	.062	.352	.063	.360
Owner-Occupied Housing	.055	.269	.056	.281
Average Overall Cost of Capital	.066		.067	
Standard Deviation	.015		.011	
Average Overall Tax Rate	.391		.405	
Interest Rate	.102		.099	

*The choice between the old and new view of dividend taxes does not affect the noncorporate sector, owner-occupied housing, or the overall interest rates.

Table 6.5 shows summary measures of investment incentives under the old view. Tax reform in this case has only a small effect on corporate and overall investment incentives. The lower tax on dividends helps offset both the higher tax on retentions and the less generous depreciation allowances. Thus, the effective tax rate in the corporate sector rises only slightly (by 1.8 percentage points) as a result of tax reform. The modest rise in the corporate sector cost of capital and effective tax rate, combined with a nearly constant cost of capital in the noncorporate sector means that, under the old view, tax reform does not markedly worsen distortions at the corporate/noncorporate margin. In addition, since the cost of capital for owner-occupied housing still rises slightly as a result of tax reform, distortions between noncorporate investment and owner-occupied housing are reduced. For these reasons, tax reform reduces the standard deviation of the cost of capital under the old view more than it does under the new view.

Next, Table 6.6 shows marginal effective tax rates by industry for both of our financing assumptions. Under prior law, and using new view financing assumptions, these industry effective rates range from 25.4 percent in the services industry to 44.3 percent in the transportation equipment industry. The services industry has a low effective tax rate because it is more than one-half noncorporate. Generally, manufacturing industries, including transportation equipment, face above average effective tax rates because they are largely corporate. Utilities face a relatively low effective tax rate,

Table 6.6 **Marginal Effective Total Tax Rates for Each Industry**

	New View		Old View	
Industry	Prior Law	Tax Reform Act of 1986	Prior Law	Tax Reform Act of 1986
1 Agriculture, Forestry and Fisheries	.361	.354	.366	.356
2 Mining	.310	.442	.392	.469
3 Crude Petroleum and Gas	.358	.399	.424	.427
4 Construction	.378	.427	.448	.455
5 Food and Tobacco	.469	.469	.500	.504
6 Textiles, Apparel and Leather	.400	.457	.488	.492
7 Paper and Printing	.355	.454	.450	.489
8 Petroleum Refining	.429	.484	.514	.518
Chemicals and Rubber	.346	.453	.447	.489
10 Lumber, Furniture, Stone, Clay & Glass	.379	.458	.468	.492
11 Metals and Machinery	.409	.467	.499	.502
12 Transportation Equipment	.443	.473	.527	.509
13 Motor Vehicles	.365	.466	.466	.502
14 Transportation, Communication & Utilities	.270	.443	.370	.475
15 Trade	.422	.433	.487	.462
16 Finance and Insurance	.364	.386	.384	.394
17 Real Estate	.303	.314	.303	.314
18 Services	.254	.403	.313	.422
Total	.347	.387	.391	.405

even though they are mostly corporate, because they could make extensive use of the investment tax credit.

Tax reform changes the relative treatment of industries, and generally raises effective tax rates under these assumptions. Agriculture and real estate are now the low-tax industries, reflecting the benefit of rate reduction for nondepreciable land.[18] Transportation equipment remains the high-tax industry, due largely to repeal of the investment tax credit. Services face an above-average effective tax rate because of repeal of the investment tax credit and the longer recovery period for real property. Utilities also face an above-average effective tax rate, again due largely to repeal of the investment tax credit.

Industry effective tax rates for both prior law and tax reform are generally higher under the old view than under the new view. The ranking of industries by effective tax rate is also changed, reflecting the higher effective tax rates in the corporate sector under the old view. However, low tax industries are still largely noncorporate industries such as real estate and services. Tax reform has a smaller effect on industry investment incentives under the old view because effective tax rates in the corporate sector are not much changed from prior law.

III. The General Equilibrium Model

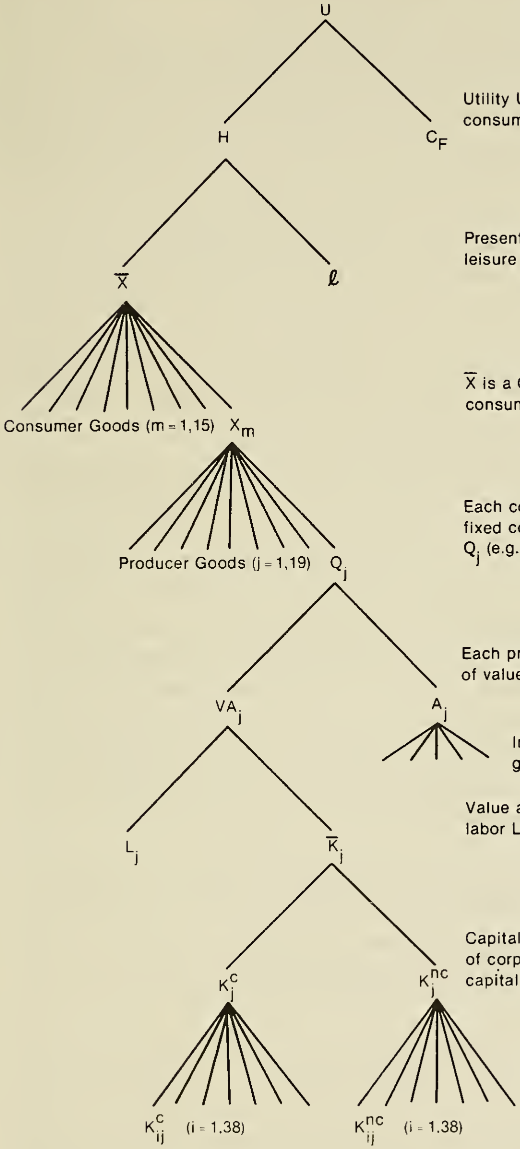
The investment incentives measured in the previous section are used as inputs into the general equilibrium model developed in Fullerton and Henderson (1986a). This model is capable of simulating the effects of tax reform on production by different industries, as well as on aggregate output. Furthermore, because of the detail on capital formation, it can trace the flow of capital simultaneously among different assets and sectors.

A. A Description of the Model

The consumption side of the model is taken directly from the general equilibrium model of Fullerton, Shoven, and Whalley (FSW, 1978, 1983), as fully described in Ballard, Fullerton, Shoven, and Whalley (1985). Twelve income-differentiated households have initial endowments of labor and capital that can be sold for use in production. As indicated in the top part of Figure 6.1, these households each maximize a nested constant elasticity of substitution (CES) utility function by making an initial allocation of resources between present consumption and saving. The elasticity of substitution between present and future consumption is based on an exogenously specified aggregate estimate for η, the uncompensated savings elasticity with respect to the net rate of return. We examine alternative savings elasticities.[19]

In evaluating any tax reform the model simulates a sequence of equilibria in which the capital stock increases as a result of saving in the previous

Figure 6.1 A Diagrammatic Summary of the Model



Utility U is a CES function of present consumption H and future consumption C_F.

Present consumption H is a CES function leisure ℓ and a composite good $\overline{X}$.

$\overline{X}$ is a Cobb-Douglas composite of the 15 consumer goods X_m.

Each consumer good X_m (e.g., appliances) is a fixed coefficient mix of the 19 producer goods Q_j (e.g., metals, transportation, and trade).

Each producer good Q_j uses fixed proportions of value added VA_j and intermediate inputs A_j.

Intermediate inputs are the 19 producer goods, in fixed proportions for each industry.

Value added VA_j is a CES function of labor L_j and capital $\overline{K}_j$.

Capital $\overline{K}_j$ in each industry is a CES function 1/ of corporate capital K_j^c and noncorporate capital K_j^{nc}.

Use of capital in each sector is a CES function of the 38 asset types.

1/ In the housing industry, capital is a CES function of owner-occupied housing and noncorporate rental housing.

period. Domestic saving is the only vehicle by which investment can be affected, since the model is not open to international capital flows. The model is open to balanced trade in commodities, but there is no scope for saving by foreigners to finance domestic capital formation.

With present resources, as indicated in the next level of Figure 6.1, a household can choose to buy some of its own labor endowment for leisure. The elasticity of substitution between consumption and leisure is based on an aggregate estimate of 0.15 for the uncompensated labor supply elasticity with respect to the net-of-tax wage. Present consumption expenditures are then divided among 15 consumer goods according to a Cobb-Douglas subutility nest. Each consumer good is a fixed-coefficient combination of outputs of the 18 industries. The model includes the entire spectrum of federal, state, and local taxes. These are typically modeled as *ad valorem* tax rates on purchases of appropriate products or factors.[20]

The Fullerton-Henderson amendments to this model come in the specification of production decisions. It is a generalized equilibrium model with endogenous allocation of capital across industries, sectors, and assets.

The structure of production is displayed in the bottom half of Figure 6.1, where each industry determines its use of factors in a sequence of stages. The first two stages are similar to the FSW model. First, producers have fixed requirements of intermediate inputs and value-added per unit of output. Second, they can substitute between labor and capital in a CES value-added function. The elasticity of substitution between labor and capital in each industry is chosen from an average of econometric estimates in the literature. These average elasticity estimates vary from 0.7 to 1.0 across the 18 private industries. However, this stage differs from the FSW model which constructs capital costs from observed tax payments. Instead, a Hall-Jorgenson (1967) type cost-of-capital formula determines the demand for composite capital $\bar{K}_j$ in each of the 18 private industries, emphasizing investment incentives at the margin.

The new model also adds a third and fourth stage to production decisions. In the third stage, for each industry j, producers decide how to allocate the composite capital good between the corporate sector and the noncorporate sector.[21] This allocation is made on the basis of the CES function:

$$K_j = \left[(\beta_j)^{\frac{1}{\sigma}} (K_j^{nc})^{\frac{\sigma-1}{\sigma}} + (1-\beta_j)^{\frac{1}{\sigma}} (K_j^{c})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{6.4}$$

The parameter σ is the elasticity of substitution between corporate and noncorporate capital. It measures the ease with which capital may be switched from one sector to the other. The parameter β_j measures the relative importance of the noncorporate sector in industry j, while K_j^c and K_j^{nc} are the corporate and noncorporate capital stocks in the jth industry, respectively. The industry's demands for capital of each type are determined by cost minimizing behavior using ρ^{c}_{j} and ρ^{nc}_{j}, composite corporate and noncorporate costs of capital within each industry. The Lagrangian multiplier from this minimization provides the composite cost of capital for the industry, mentioned above.

In the fourth stage of production decisions, firms in each sector of each industry allocate their composite capital among depreciable assets, land, and inventories, according to a CES function. For corporate firms, the function is written as:

$$K_{j} = \left[\Sigma_{i=1}^{38} (\alpha^{c}_{ij})^{\frac{1}{\varepsilon}} (K^{c}_{ij})^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}} \qquad (6.5)$$

The parameter ε is the elasticity of substitution among assets, assumed constant across assets, industries, and sectors. The parameter α^{c}_{ij} shows the importance of asset type i in the corporate sector of industry j. The stock K^{c}_{ij} is the amount of capital of the ith asset type in corporate sector of the jth industry. The disaggregate capital demands K^{c}_{ij} are obtained through cost minimizing behavior based on individual assets' costs of capital from equation (6.1). The Lagrangian multiplier from this minimization provides ρ^{c}_{j}, the composite corporate cost of capital for the jth industry. A similar equation is minimized to obtain demands for capital in the noncorporate sector of each industry, and to obtain ρ^{nc}_{j}, the composite noncorporate cost of capital. Econometric estimates are not available for the key parameters σ, ε, α_{ij}, and β_{ij}. As a consequence, the values of σ and ε are specified exogenously (but results for alternative specifications are reported below). The other key capital allocation parameters, α_{ij} and β_{ij}, are determined from the initial set of capital costs and the observed allocation of capital in the baseline case (prior law). Once σ and ε are specified, we solve backwards for the α_{ij} and β_{ij} that must have pertained if producers actually had the observed demands while facing the initial costs of capital. This calibration allows the model to find the observed or "benchmark" equilibrium as a solution for the model when producers face initial capital costs. Once calibrated in this manner, α_{ij} and β_{ij} remain constant across tax policy changes.

For a given set of technological parameters, the allocation of capital depends ultimately on user costs for individual asset types. As described above, these are built up from information on statutory tax rates, credit rates, tax lifetimes, and other statutory specifications. These costs also depend endogenously on the real after-tax rate of return, s, determined in equilibrium. These disaggregate asset costs are used directly for each sector to determine allocations among assets in the last stage of Figure 6.1. A composite of those capital costs is calculated for the corporate sector and for the noncorporate sector of each industry, in order to determine the allocation between sectors in the next-to-last stage of Figure 6.1. Finally, an additional composite of the two sectors is calculated for each industry, in order to determine the allocation of capital among industries. Thus, each industry has a different mix of assets in each sector, as well as a different mix of sectors, all determined endogenously. When the total use of capital equals the total available supply, we have equilibrium in the capital market; when other markets clear as well, we have a general equilibrium.

An important advantage of this model is that it is not limited to a unitary elasticity of substitution among assets, as implied by the Cobb-Douglas functional form common in previous studies. Instead, the elasticity of substitution among assets (ε) and among sectors (σ) may be specified exogenously. These generalizations are important because the choices of ε and σ, as well as of η, have much bearing on the relative size of different distortions and therefore on the net effect of tax reform. If ε is high, for example, then the change in the relative tax treatment of different assets will result in a more significant change in the firm's production technology. A high value for ε will therefore imply relatively high welfare gains from the more uniform tax treatment of different assets. If σ is high, then the sectoral allocation of capital is more sensitive to changes in the relative tax treatment of corporations, noncorporate business, and owner-occupied housing. High values of σ would be associated with high welfare gains from more uniform tax treatment of sectors. Finally, the choice of η, the savings elasticity, matters for aggregate capital accumulation. If η is high, then any change in the overall taxation of the return to income from capital would result in a higher saving response. As this assumed elasticity rises, any tax wedge between the gross and net return to saving results in a greater measured efficiency loss.

B. Simulation and Sensitivity

Before presenting the results themselves, it is necessary to describe our simulations. We simulate a sequence of 6 equilibria that are 10 years apart, so our total simulation interval is 50 years. All our simulations assume an adjustment in lump-sum taxes (positive or negative as appropriate) in order to restore the revenue yield of the baseline. We perform the simulations for each view of dividend taxes under several alternative sets of parameters.

We consider values of ε and σ between 0.15 and 2.5, and values of η between 0 and 0.6. As stressed in Fullerton and Henderson, (1986a) existing econometric work on substitution elasticities does not consider the number of assets included in this model. Neither does it attempt specifically to measure a sectoral substitution elasticity. There remains considerable uncertainty about these parameter values. For the savings elasticity, our lower bound of zero is consistent with the estimate of Howrey and Hymans (1978), and our upper bound of .6 is in the upper range of estimates in Boskin (1978).

Under the new view of dividend taxation, tax reform increases distortions between present and future consumption, for which η is important. Under the old view, this effect is similar but smaller. Under both views, tax reform reduces distortions in the choice among assets, for which ε is important.

Thus, assessment of the overall efficiency effects of tax reform depends on the relative sizes of ε and η. The effect of tax reform on intersectoral distortions is slightly more complicated. Under both the new and old views, corporate/noncorporate distortions are magnified while noncorporate/owner-occupied housing distortions are reduced. If we adopt the new view so that the corporate/noncorporate distortion is more greatly affected by tax reform, then it seems likely that increases in σ will reduce any efficiency gains bought on by reduction in interasset distortions. In contrast, if we adopt the old view, the corporate/noncorporate distortion is only slightly increased by tax reform. Thus, increases in σ might increase or decrease efficiency gains, depending on whether the improvement in the margin between noncorporate rental housing and owner-occupied housing more than offsets the effect of the margin in other industries between the corporate sector and the noncorporate sector.

C. Interpretation of Simulations

Simulation analysis such as we perform here can provide highly detailed results. It is always necessary to bear in mind, however, the limitations of such studies. We would like to mention three types of issues: the quantification of tax reform measures; the specification of economic behavior; and the usefulness of our results for policy decisions.

First, although our simulations take into account major elements of the tax reform proposals as they pertain to capital formation, they do not take into account all aspects of fundamental tax reform. For example, while we capture the effect of capital gains changes on the overall incentive to invest, we do not capture their effect on holding periods or realizations. We do not capture the effect of tax reform on incentives to churn assets, to merge with other firms, to increase compliance, or to join the labor force. We omit the alternative minimum tax and the passive loss rules. In addition, we do not capture new features that could have sizable influences on particular industries. Examples include special features that relate to energy and to accounting for multiperiod production.[22]

Second, any simulation model necessarily simplifies some aspects of economic decisionmaking. One example relevant to our model is the specification of financial choices. Tax reform raises the cost of debt finance for corporations, yet we do not alter firms' debt-equity ratios to reflect this change. Also, we have made specific choices with respect to capital allocation decisions. Our use of the ε parameter implies that firms view all assets as substitutes for one another in production; we omit the possibility that some assets are complements. Our use of the σ parameter attempts to capture the impact of capital costs on incorporation decisions, but we do not explicitly model the effect on these decisions of providing limited liability or access to national financial markets.

Finally, it should be emphasized that we do not consider the effects of tax reform on "fairness" or "simplicity," concepts that were important throughout the development of the tax reform process. Any changes in the achievement of these other goals would be additional criteria by which to assess tax reform. In summary, the various results found in the next section must necessarily be interpreted with caution. Any overall evaluation of tax reform should use appropriate additional information and judgment.

IV. General Equilibrium Results

A. The Net Effect on Economic Well-being

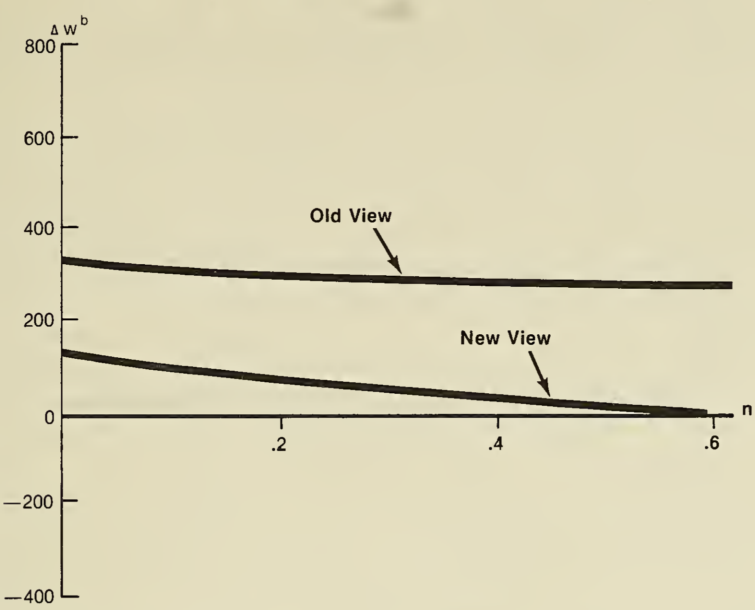
Previous literature provides very little guidance in the selection of values for our three key elasticity parameters. Therefore our strategy here is to select one set of parameters for a starting point and then to vary each parameter systematically. The starting point is taken to be the case where $\varepsilon = 1$, $\sigma = 1$, and $\eta = .4$, so that asset and sectoral combinations are Cobb-Douglas and savings are moderately responsive to net returns.

Under the "new view," with these parameters, the net effect of tax reform is a $54 billion present value welfare gain, measured by the sum of equivalent variations over the twelve consumers, in 1984 dollars. This gain is 0.04 percent of the present value of real income in the baseline. The increase in economic well-being is achieved despite the reduction of investment incentives. That is, the greater efficiency of investment more than compensates for a lower total. The capital stock is still growing, of course, but after 50 years it is 1.9 percent lower than it would have been under prior law. Under the "old view," with the same elasticity parameters, the net effect of tax reform is a $302 billion present value welfare gain (0.2 percent of baseline income). The overall cost of capital does not rise as much in this case, so increases in allocation efficiency are offset to a lesser degree. This more-efficient capital stock is only 0.6 percent lower than in the baseline after 50 years.

The next three figures display the net effects of varying the three elasticity parameters one at a time.

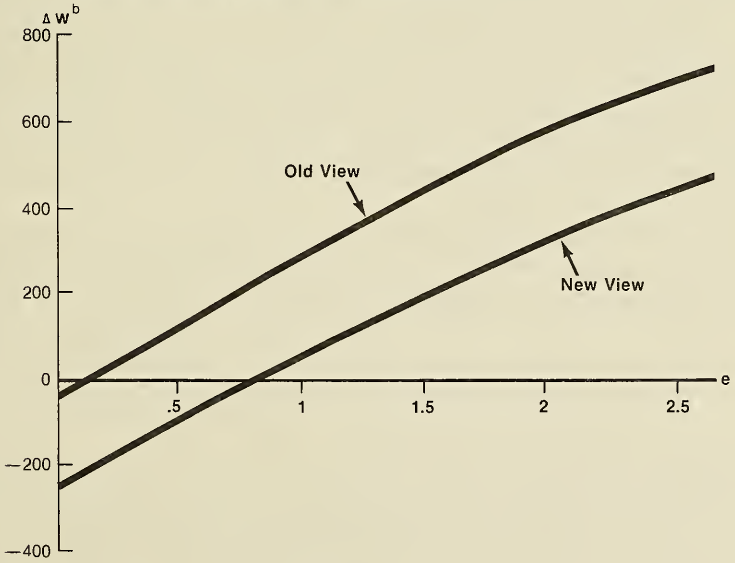
Figure 6.2 shows the effect of alternative savings elasticities. The vertical axis measures the present value change in welfare, and the horizontal axis shows values of η ranging from 0 to .6 (while $\varepsilon = \sigma = 1$). As expected, welfare gains fall as η increases. However, for both views of dividend taxation, welfare gains are positive for all values of η that we consider. Under the old view welfare gains range from $337 billion to $286 billion. Under the new view, welfare gains are smaller, ranging from $141 billion to $13 billion. Welfare gains are larger for the old view because dividend tax reductions are more important. As indicated in Tables 6.5 and 6.6, tax reform in this case causes a smaller increase in overall effective tax rates, a larger improvement in interasset neutrality, and a smaller increase in the intersectoral distortions. Because tax reform raises effective tax rates more sharply under the new view, the slope of the curve for the new view is steeper.

Figure 6.2 **Savings Elasticity and the Welfare Gain from the Tax Reform Act of 1986**[a]



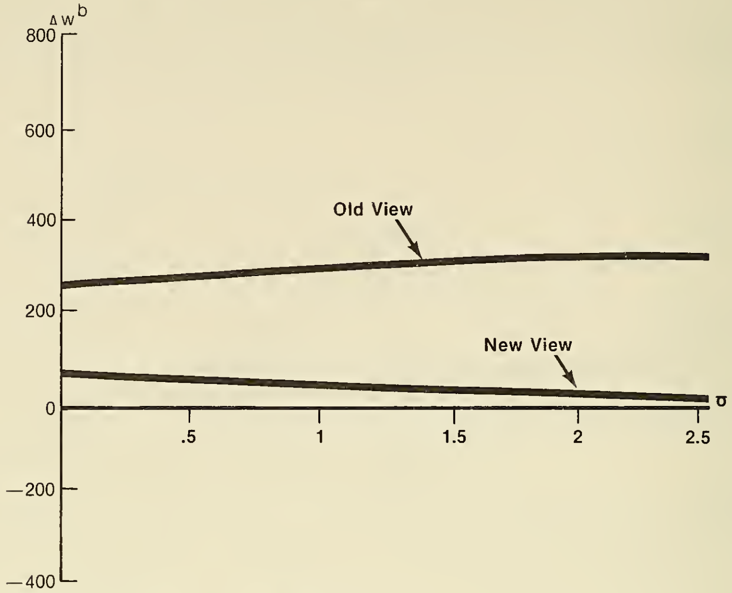
[a] Calculations assume σ = ε = 1.
[b] In billions of 1984 dollars.

Figure 6.3 **Asset Substitution and the Welfare Gain from the Tax Reform Act of 1986**[a]



[a] Calculations assume σ = 1 and η = .4.
[b] In billions of 1984 dollars.

Figure 6.4 **Sectoral Substitution and the Welfare Gain from the Tax Reform Act of 1986**[a]



[a] Calculations assume ε = 1 and η = .4.
[b] In billions of 1984 dollars.

Figure 6.3 plots the relationship between tax reform's welfare effects and ε, the elasticity of substitution across assets (while $\sigma = 1$ and $\eta = .4$). Because tax reform improves interasset neutrality, welfare gains rise with ε and reach a maximum of $733 billion under the old view when $\varepsilon = 2.5$. However, with very low substitutability among assets, tax reform can actually reduce welfare: adverse effects on savings and the intersectoral allocation of capital offset the smaller favorable effects on interasset neutrality. As in Figure 6.2, tax reform has more favorable effects on welfare under the old view than under the new view.

Figure 6.4 illustrates the relationship between the economic benefits of tax reform and σ, the parameter for intersectoral substitution possibilities (while $\varepsilon = 1$ and $\eta = .4$). For all values of σ between 0.15 and 2.5, our simulations indicate positive welfare effects under both the new and old views of dividend taxation. Because of the increase in all intersectoral distortions under the new view, welfare improvements fall as σ rises. The fact that they remain positive shows that asset substitution effects dominate sectoral substitution effects even when σ rises to 2.5. Under the old view, tax reform generates improvements in welfare that rise as σ rises. The positive slope reflects the smaller increase in corporate/noncorporate distortions under the old view. As in Figures 6.2 and 6.3, tax reform stimulates larger improvements in welfare when the reduction in dividend taxation has a larger effect and the increase in capital gains tax has a smaller effect.

B. Allocation of Capital Among Assets and Sectors

Under prior law, investment in equipment is tax-favored as a result of the investment tax credit and very short lifetimes for depreciation. At the other extreme, returns to investments in inventories and land face statutory tax rates.

Tax reform narrows the differences in these tax treatments. As a result, firms alter their relative demands for these assets. Table 6.7 illustrates this reallocation for the corporate sector, for the case where $\sigma=1$, $\varepsilon=1$, and $\eta=.4$, with both the "new view" and the "old view." Similar reallocations take place in the noncorporate business sector. Under our 1984 baseline data, 29.5 percent of the corporate capital stock is in the form of equipment. Under the new view, with tax reform, this share would drop to 20.5 percent. The percentage for inventories would increase from 34.2 to 41.2 percent under tax reform. The use of land and structures in the corporate sector would also increase. The corporate sector would use a smaller share of public utility property. Results for the old view are similar. In the simulations with a higher value of ε (not shown), these reallocations are in the same direction but larger in magnitude. As the asset elasticity parameter increases, corporations change their production processes more sharply in reaction to changes in relative user costs for different assets.

Because it changes relative investment incentives, tax reform redistributes capital across the three sectors of the economy. Table 6.8 shows the results of this redistribution. Under the new view of dividend taxation, the corporate sector cost of capital rises by 15 percent, from .065 to .075, while the costs of capital in the noncorporate and owner-occupied housing sectors are largely unchanged. After 50 years, this 15 percent increase in the cost of capital in the corporate sector leads to an 8 percent reduction in the fraction of capital employed in the corporate sector. The capital flowing out of the corporate sector goes largely into the noncorporate sector. Owner-occupied housing is only slightly increased as a percentage of the overall stock of capital. Table 6.8 also shows results for the old view of dividend taxation. Under this alternative assumption capital shares are less sensitive to tax reform. This reflects smaller effect of tax reform on intersectoral investment incentives when dividend taxation is more important and capital gains are less important. The changes in shares, however, follow the same pattern as under the new view.

C. Results for Industries

As was indicated in Table 6.7, tax reform encourages the use of nondepreciable assets such as land and inventories. It also expands the noncorporate and owner-occupied housing sectors relative to the corporate sector, especially under the new view of dividend taxation. Thus, we would expect that noncorporate industries using relatively large amounts of land and inventories would expand relative to other industries as a result of tax reform.

Table 6.7 Eventual Allocation of Corporate Capital Across Asset Types*

	Prior Law	Tax Reform Act of 1986 New View	Tax Reform Act of 1986 Old View
	(After fifty years. as proportion of total)		
Equipment	.295	.205	.213
Nonresidential Structures	.149	.156	.154
Public Utility Structures	.112	.105	.104
Inventories	.342	.412	.409
Land	.101	.122	.120

*Calculations assume $\sigma = \varepsilon = 1$, and $\eta = .4$

Table 6.8 Eventual Allocation of Capital Across Sectors*

	Prior Law	Tax Reform Act of 1986 New View	Tax Reform Act of 1986 Old View
	(After 50 years as a proportion of total)		
Corporate	.373	.343	.364
Noncorporate	.371	.394	.378
Owner-occupied Housing	.257	.263	.258

*Calculations assume $\sigma = \varepsilon = 1$, and $\eta = .4$

Table 6.9 shows the induced changes in output and capital in each of 18 private industries. We start with the new view of dividend taxation. Agriculture, which is largely noncorporate and uses a large proportion of land, experiences the largest percentage increase in output and capital. No industry other than agriculture experiences increases in output or capital of larger than 3 percent. Utilities and mining experience the largest contraction of output and capital as a result of tax reform. Overall, under the new view, tax reform causes a .4 percent reduction in output and a 1.9 percent reduction in capital.

Under the old view, in general, induced changes in output and capital are proportionally smaller. Capital falls by .6 percent. Output. however. rises by .2 percent. Agriculture again experiences the largest percentage increase in output, and utilities still experience the largest percentage reduction in output. However, the transportation equipment industry now experiences the largest percentage increase in capital. followed by agriculture. Capital in the utility industry continues to contract the most under the old view.

The treatment of dividend taxation also can affect the sign of changes in output and capital for certain industries. The metal and machinery industry.

Table 6.9 **Eventual Output and Capital Stock by Industry**[a]

		Baseline after fifty years (billions of 1984 dollars)		Tax Reform Act of 1986[b]			
				New view		Old view	
	Industry	Output	Capital	Output	Capital	Output	Capital
1	Agriculture, Forestry & Fisheries	794	6,255	8.9%	9.0%	5.5%	5.4%
2	Mining	94	204	-5.3%	-17.6%	-3.2%	-12.3%
3	Crude Petroleum and Gas	106	917	-3.8%	-4.3%	-.9%	-.8%
4	Construction	659	708	-1.5%	-5.9%	-.4%	-1.3%
5	Food and Tobacco	960	454	2.2%	-2.9%	2.1%	1.1%
6	Textiles, Apparel & Leather	472	179	-.4%	-6.1%	.6%	.0%
7	Paper and Printing	352	347	-.9%	-12.1%	.0%	-5.8%
8	Petroleum Refining	234	252	-1.7%	-5.6%	.4%	-.8%
9	Chemicals and Rubber	519	586	-2.1%	-14.0%	-.8%	-7.2%
10	Lumber, Furniture, Stone, Clay & Glass	357	296	-.8%	-9.8%	-.0%	-3.4%
11	Metals and Machinery	1,545	2,025	-2.0%	-7.3%	.4%	-.5%
12	Transportation Equipment	147	246	.7%	-1.2%	3.0%	6.5%
13	Motor Vehicles	430	280	-2.1%	-13.2%	-.5%	-5.7%
14	Transportation, Communiction & Utilities	1,085	3,308	-5.0%	-20.2%	-3.8%	-14.7%
15	Trade	1,641	4,438	-.2%	.8%	.7%	4.8%
16	Finance and Insurance	594	572	-.5%	-.5%	-.2%	.7%
17	Real Estate	1,139	10,897	.6%	.7%	.1%	.0%
18	Services	1.707	887	-.8%	-16.8%	-.4%	-14.3%
	Total[c]	12,836	32,855	-.4%	-1.9%	.2%	-.6%

[a] Calculations assume $\sigma = \varepsilon = 1$ and $\eta = .4$.
[b] Percent change from the baseline.
[c] Detail may not add to total due to rounding.

for example, experiences a 2 percent reduction in output under the new view, but a .4 percent increase in output under the old view. The food and tobacco industry experiences almost a 3 percent reduction in capital under the new view, but over a 1 percent increase under the old view.

V. Summary

We have used the disaggregate general equilibrium model developed in Fullerton and Henderson (1986a, b) to analyze the Tax Reform Act of 1986. This model focuses on measuring changes in the taxation of income from real capital assets. It is capable of measuring the net effects of changes in statutory rates, credits, and depreciation allowances on the allocation of capital among assets, sectors, and industries. It also captures the effect on total savings and investment of changes in overall incentives.

We find that under a wide variety of parameter values, reform of capital taxation results in net improvements in welfare. This result holds even though in many instances both output and capital formation fall slightly as a result of tax reform. The provisions of tax reform that affect capital tend to stimulate production in industries such as agriculture that employ large amounts of nondepreciable assets fully benefiting from statutory rate reduction. We also find that results are sensitive to the relative importance of dividend and capital gains taxation. If dividend taxes are a significant source of distortion in the allocation of capital, then tax reform compares more favorably with prior law than if dividend taxation is unimportant.

FOOTNOTES

[1] This paper does not consider the effects of these rate cuts on labor income and labor supply. We concentrate exclusively on their effects on capital.

[2] The effects of uncertainty and imperfect loss offsets are investigated in Auerbach (1986) and Auerbach and Poterba (1987).

[3] For a variety of reasons not captured here, firms may not always minimize their taxes by taking the earliest possible deductions. In order to concentrate on the tax wedge and to insure comparability across tax regimes, however, calculations here assume tax minimizing behavior. Similarly, firms pay unnecessary taxes by using FIFO inventory accounting, so calculations here assume LIFO methods. The effect of FIFO inventory accounting is shown in Fullerton (1987).

[4] For the social rate of return in the noncorporate sector, ρ^{nc}, we use an expression analogous to 6.1 where u is replaced by τ_{nc}, the marginal rate on noncorporate business income, and r is replaced by the corresponding noncorporate discount rate. Since owner-occupied housing receives no credit or depreciation allowances, the analogous expression in that sector is $\rho^h = r - \pi + (1-\lambda\tau_h)w$, where τ_h is the marginal rate at which interest and property taxes are deducted and λ is the fraction of property taxes deducted by homeowners.

[5] If individuals earn the same rate of return net of all taxes from debt and equity, then the firm must earn a higher marginal product on a project financed by equity than on the same project financed by debt. In a context of perfect certainty, this can be justified only if for some reason firms must use a given mix of finance. Here, we do not model the role of uncertainty or institutional restrictions that influence observed financing choices. These choices are taken to be exogenous. An alternative assumption might be that firms, rather than individuals, arbitrage between debt and equity. The effects of firm arbitrage on measured tax rates are explored in Fullerton and Henderson (1984), and Fullerton (1987) as well as Fullerton, Gillette and Mackie (1987, this volume). This alternative view would be supported in the perfect certainty framework only if individuals in different income groups specialize in different assets, as in Miller (1977).

[6] In the noncorporate sector, the discount rate is $n_d i(1-\tau_{nc}) + n_e i(1-\tau_d)$, where n_d and n_e are the fractions of noncorporate investment financed by debt and equity, respectively. The rate τ_{nc} is the marginal rate on noncorporate business income, and τ_d is the marginal rate on interest income. In the owner-occupied housing sector, the discount rate is $h_d i(1-\tau_h) + h_e i(1-\tau_d)$, where h_d and h_e are the fractions of owner-occupied housing investment financed by debt and equity, respectively, and τ_h is the marginal rate at which homeowners deduct interest payments and property taxes.

[7] Total effective tax rates are meaningful in our model with no international capital flows, because all taxes on capital affect total savings and investment. They may not be as meaningful in a more open economy where corporate taxes affect primarily investment and personal taxes affect primarily savings.

[8] See Cilke and Wyscarver (1987, this volume) for further description of this model.

[9] See page 221 of King and Fullerton (1984).

[10] The adjusted rate for households is .267 under prior law and .232 under Tax Reform. The weights for households, tax-exempts, and insurance companies are .609, .153, and .238 respectively. Under prior law, a special 20 percent deduction reduced the rate on insurance companies from 46 to 36.8 percent. The Tax Reform Act repeals this special deduction and leaves them with the same 34 percent rate as other corporations.

[11] For dividends and capital gains, we use weights given by the holdings of corporate stock: .743 for households, .216 for tax-exempt institutions, and .041 for insurance companies. The dividend rate of insurance companies was .069 under prior law and .068 under tax reform, accounting for the intercorporate dividend deduction.

[12] See King and Fullerton (1984, pages 221-222).

[13] Consider first a firm that wishes to invest $1 more by issuing $1 of new shares. The asset earns a return r, net of corporate tax, which the firm pays out as a dividend. The ultimate return to the new shareholder is this $(1-\tau_{ns})r$. Alternatively, consider a firm that wishes to invest in $1 more of capital by retaining an additional dollar of earnings. To retain an extra dollar, the firm must necessarily reduce dividend payments. The $1 dividend foregone represents $\$(1-\tau_{ns})$ net of personal tax. In the following period the asset earns a return r net of corporate tax and $(1-\tau_{ns})r$ net of personal tax. The return to shareholders relative to dividends foregone in the first period is just r. This return is independent of the parameter τ_{ns} since it affects identically the numerator and denominator in the calculation of the rate of return.

[14] The new view receives empirical support in a study by Auerbach (1984), but the old view is found more compatible with historical evidence in Poterba and Summers (1983, 1985). Poterba and Summers (1985) also explain some conceptual problems associated with each theory.

[15] Starting from the 35 depreciable assets listed in Table 6.2, the corporate sector in this model excludes residential structures but includes land and inventories.

[16] A subsidy, or negative effective tax rate, means that tax credits and depreciation allowances are so generous that they outweigh the effects of taxes on net income and property values. Under a subsidy, to earn $s = .04$ after tax, the required value of ρ is lower than 4 percent.

[17] From the July 1985 Survey of Current Business, we obtain 1981 data for corporate equipment, corporate structures, noncorporate equipment, and noncorporate structures. We also obtain data for total depreciable capital stocks by 18 industries. We project each of these 22 capital stock figures to 1984 by using an econometric estimate of the relationship between economic growth and capital formation. We then use an RAS procedure with these 1984 targets to adjust an unpublished 1977 matrix from Dale Jorgenson, showing each of these four types of asset used in each of the 18 industries. Finally, we obtain the finer capital allocations for all 20 types of equipment and 15 types of structures, by using disaggregate proportions in the Jorgenson data. These data also form the basis for our 1984 projections of the values of land and inventories in each of our industries.

[18] This model considers fully taxable firms and infinite holding periods. It thus omits changes in the alternative minimum tax, passive loss rules, and the churning of tax shelter assets such as those in real estate. Also, we assume the same financing shares for all assets in all industries.

[19] Our model assumes that households' expectations of the rate of return are myopic. Ballard and Goulder (1985) examine the effect of incorporating perfect foresight into the Fullerton-Shoven-Whalley model.

[20] The model also requires that government run a balanced budget. Therefore, when our simulations raise (lower) national output and income, we must offset the resulting revenue gains

(losses) by cutting (increasing) some other tax. We do this by changing income taxes in a lump-sum manner. We thus abstract from changes in personal taxation of labor income.

[21] In the housing industry, producers instead allocate the composite capital good between owner-occupied housing and noncorporate rental housing.

[22] See Fullerton, Gillette and Mackie (1987, this volume) for additional work in this area. They find that these cost of capital measures are relatively unaffected by accounting changes, cost capitalization, and other provisions that are not modelled here. These provisions affect the timing of revenue more than they affect the present value of tax on marginal investment. Indeed, it is because tax revenue is often a poor guide to investment incentives that we turn to the concept of the cost of capital. Still, because the cost of capital cannot account for every feature of the tax code, it may omit important effects on incentives.

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7 THE TREASURY DEPRECIATION MODEL

Geraldine Gerardi, Hudson Milner, Leslie Whitaker,
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I. INTRODUCTION

Depreciation reform was a controversial issue during the tax reform debate with numerous depreciation systems proposed. The debate over depreciation concentrated primarily on the proper balance between lower statutory rates and greater depreciation allowances, and secondarily on improvements in the measurement of income through both more realistic measures of depreciation and adjustments for inflation. The principal model the Office of Tax Analysis used to evaluate the revenue consequences of depreciation proposals was the Treasury Depreciation Model.

For any proposed tax system the depreciation model calculates depreciation deductions based on investment estimates by type of asset within a set of industries. These estimates enable the model to operate between the micro level of the firm, where investment is difficult to forecast, and the macro level, where detail is inadequate to evaluate alternative tax proposals. The investment estimates are derived primarily from data on investment by industry and type of asset for 1970 through 1985 from the Bureau of Economic Analysis (BEA). The BEA data are modified for use in the depreciation model to exclude investment that is not eligible for depreciation, to extrapolate investment to 1992, to allocate investment to depreciation categories, and to allocate investment to the corporate and non-corporate sectors. The model currently considers 72 assets in 55 industries.

Although these investment estimates provide the basic data to the model, they must be supplemented by other data to calculate changes in deductions and tax revenues. For example, tax return data from the IRS Statistics of Income are used to estimate the amount of investment depreciated by each depreciation method and the amount of tentative depreciation and investment credit changes carried back or forward as a result of inadequate taxable income.

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To compute total changes in calendar year tax liabilities as a result of alternative depreciation proposals, the model calculates the change in depreciation claimed in the current year by adding to the tentative current change the carryforward deductions from prior years, subtracting the amounts not usable in the current year and adding the amounts carried back to prior years. Calendar year tax liabilities are then computed by multiplying the change in deductions for the year by each sector's effective tax rate (calculated from both statutory tax rates and simulations of the Treasury's corporate tax model) to determine the relationship between depreciation deductions and taxable income. The depreciation model also computes the investment tax credit (ITC) claimed for each year in the simulation period, including the interaction of depreciation deductions and ITC carrybacks and carryforwards.

The depreciation model was used to estimate the revenue effect of the changes in the ITC and depreciation provisions under the Tax Reform Act of 1986. The Act generally repealed the ITC for equipment, which under prior law generally was 10 percent of qualified investment. In addition to repealing the ITC, the Act reduced the amount of tax credits that could be carried over to future years. The Act changed the provisions governing depreciation allowances by replacing the six recovery period classes under prior law with eight classes–six for personal property and two for real estate. The Act also modified expensing provisions.

Based on the Administration's August 1986 investment forecast, the model shows that the changes in the ITC and depreciation would increase calendar year tax liabilities by approximately $256 billion through 1992. After certain "off model" adjustments, the estimates were approximately $260 billion over this calendar year period and about $231 billion over the fiscal year period ending with fiscal year 1992.

The results described in this paper illustrate one use of the depreciation model–estimating the revenue effect of a change in the tax law over a certain period of years. The model is also used to devise depreciation proposals with a targeted revenue cost, which may then be evaluated for their reduction in the cost of capital (see Chapter 5). Alternatively, a proposal that meets a given cost of capital objective can be evaluated for its revenue consequences. Finally, a joint goal for the cost of capital and revenue cost could be specified and depreciation proposals devised to achieve that goal.

The remainder of this paper is organized as follows. Section II describes the changes in the investment tax credit and depreciation provisions under the Tax Reform Act of 1986. Section III continues with a description of the data used by the depreciation modeling system; section IV addresses the actual model in some detail. Finally, section V presents the model's estimated revenue effects from simulating the tax reform changes in depreciation allowances and investment tax credits and discusses the results.

II. A DESCRIPTION OF ITC AND DEPRECIATION CHANGES

This section describes the changes in the investment credit and depreciation provisions under the Tax Reform Act of 1986 that were evaluated in part by the use of the depreciation model. Each change is discussed in the order it was evaluated by the model: (1) repeal of the ITC for equipment; (2) reduction of carryforwards of investment tax credits; (3) changes in expensing; and (4) changes in the depreciation provisions.

Prior to the Tax Reform Act a 10 percent ITC was generally allowed for investment in new equipment (and used equipment up to $125,000). Short-lived equipment in the 3 year Accelerated Cost Recovery System (ACRS) depreciation class was permitted a 6 percent credit. Assets that took more than one year to construct could receive credits on qualified progress expenditures (QPE's) made during the period of construction before the asset was completed and placed in service. After 1982 the basis against which depreciation allowances were permitted was adjusted down by one-half of the investment credit earned unless the credit percentage was reduced by two percentage points. Investment in buildings was not allowed an investment credit.

The Tax Reform Act of 1986 abolished the ITC after December 31, 1985, unless transition rules apply. Some property will continue to receive the investment credit for various periods through 1990 depending upon the asset depreciation range (ADR) life of the asset, provided it satisfies certain binding contract criteria or was specifically identified in the Act as transition property. The depreciable basis of assets that qualify for transition treatment are reduced by the full amount of the credit and continue to use pre-reform depreciation schedules.

Accompanying repeal of the investment credit is the elimination of basis adjustments to depreciable assets associated with investment credits and the reduction of carryforwards of investment credits. Under prior law, investment credits not usable in the current year because of inadequate tax liability were carried back 3 years and forward 15 years. Under the Tax Reform Act, tax credits carried forward from prior years and newly earned credits are allowed in full for 1986, but are reduced by 17.5 percent in 1987 and by 35 percent after 1987.

The Tax Reform Act also changed expensing provisions. Under prior law $5,000 of investment could be directly expensed (i.e., deducted in full) in 1986. This amount was scheduled to increase to $7,500 in 1988 and to $10,000 in 1990 and thereafter. The new law expands the amount eligible for expensing to $10,000 in 1987, subject to certain restrictions. The restrictions generally limit the amount expensed to taxable income derived from any trade or business. Thus, expensing deductions cannot be used to offset income from other sources. Also, the $10,000 deduction is reduced dollar for dollar as the amount of annual investment exceeds $200,000.

The Tax Reform Act also replaced the prior ACRS depreciation system with a new depreciation system. The prior ACRS system depreciated assets over 3, 5, 10, 15 and 19 years. Assets in 3, 5. 10 and 15 year classes were depreciated by a method similar to 150 percent declining balance (DB) with an switch to straight line to maximize depreciation allowances. Low-income housing and assets in the 19 year class were depreciated at 200 percent and 175 percent DB, respectively, with a switch to the straight-line method to maximize the present value of depreciation deductions.

The new depreciation system uses 200 percent DB for assets in the 3, 5. 7 and 10 year classes and 150 percent DB for assets in the 15 and 20 year classes with an optimum switch to straight line to maximize depreciation allowances. Real estate is depreciated using the straight-line method over 27.5 years for residential real estate and over 31.5 years for other real estate. The new system applies in 1987, but is optional for assets placed in service between July 31 and the end of 1986. The ADR midpoint life primarily determines the assignment of property to a class as follows:

New Life	For ADR Lives
3	4 or less
5	4.5 to 9.5
7	10 to 15.5
10	16 to 19.5
15	20 to 24.5
20	25 or more

However, certain equipment is treated differently. Autos and light trucks, research and experimentation property, and certain technological property are placed in the 5 year class. Other assets are assigned new ADR lives by statute. Assets without ADR midpoint lives are treated as 12 year ADR midpoint life assets. The Appendix contains a more detailed comparison of pre-reform and reform depreciation systems according to ADR midpoint life and asset type or industry where applicable.

The Tax Reform Act of 1986 provides an alternative depreciation system for property used predominantly outside the United States, for determining the proportion of property financed by tax-exempt bonds, and for computing earnings and profits and depreciation for minimum tax purposes. The alternative depreciation system uses the ADR midpoint life and is 40 years for structures and 27.5 years for low-income housing financed with tax-exempt bonds and the straight-line method (except for purposes of the minimum tax). The minimum tax allows the 150 percent declining balance method switching to the straight-line method for property other than real property. which continues to use the straight-line method.

Under prior law several alternative tax systems applied. The minimum tax did not apply to depreciation on ACRS personal property. However, for real property straight-line depreciation was required for minimum tax purposes over the applicable ACRS life of 15, 18 or 19 years. Leased property was required to use the straight-line method over the somewhat longer tax lives of 5, 8, 15 and 22 years for personal property and 40 years for real property except low income housing which used 18 years. Property placed in service abroad was able to use the double declining balance depreciation method with an optimum switch to the straight-line method over the ADR midpoint life for equipment. Real property placed in service abroad was limited to 150 percent declining balance with a switch to straight line over 35 years. For computing earnings and profits the straight-line method applied to the longer tax lives of 5, 12, 25 and 35 years for equipment and 40 years for real property.

III. A DESCRIPTION OF THE DATA

This section discusses the data inputs for the depreciation model. The model processes: (a) investment data disaggregated by industry, asset type, and asset depreciation range (ADR) and (b) other data which supplements the investment data to enable calculation of revenue effects.

A. The Investment Data File

The investment data file is the basic data for the depreciation model. The Office of Tax Analysis (OTA) created this file from investment data supplied by Bureau of Economic Analysis (BEA). This process consisted of four steps: (a) adjusting the investment data to investment allowed tax depreciation, (b) extrapolating the data through 1992, (c) mapping the BEA industries and asset classes into OTA industries and asset classes, and (d) splitting the data file into a corporate and non-corporate sector. The subsections below provide background about the BEA data file and describe each step of the process used to create the investment data file. A detailed discussion of BEA's estimation procedure is contained in Gorman, et.al. (1985).

B. The BEA Data

The BEA investment estimates by industry were obtained from three major sources. The first data source, BEA's plant and equipment expenditure survey, provides annual data on investment in nonresidential capital by nonfarm industries. These data are classified on a company basis and provide a two-way split by type of asset: total equipment and total structures. The second source of information is on investment in structures and durable equipment by sector (mining, construction, manufacturing, etc.), which is collected by the Census Bureau. These data are available every five years. The third source of data is the capital flow tables prepared by BEA from input-output tables for

1963, 1967, and 1972, which provide distributions of investment by asset for each industry. In those instances where data were nonexistent, adjustments were made using interpolation and extrapolation procedures calibrated to established benchmarks.

The investment flows were derived for investment in new capital by type of asset for each industry and for transfers of used assets between private business and other types of owners. The flows for each industry for investment in new and used assets were distributed by legal form of organization.

The BEA data provides estimates of investment by industry and by type of asset for 1970 through 1985. For years following 1985, investment was calculated from detailed industry growth rates obtained from long-term forecasts by Data Resources, Inc. (DRI).

C. The Data Adjustment Process

In order to use the BEA data to compute tax depreciation, several adjustments were required. In order to concentrate on depreciation deductions of taxable firms, all tax-exempt co-operatives were removed (rural electric power, telephone and wholesale trade). Similarly, all investments of nonprofit institutions were removed from the real estate industry. (BEA classified these investments in the real estate industry in order to maintain consistency with the National Income and Product Accounts, NIPA). Nondepreciable oil wells, gas wells, and mine shafts were removed from their corresponding industries. The assets of Federal Reserve Banks are also removed since they do not pay income tax.

A time series for used investment was created using basic scrap equations found in Winfrey (1935). Adjustments were made for replacement railroad tracks and major structural improvements. Special purpose agriculture structures, railroad tank cars, public utilities, coal fired burners, and other asset types were also adjusted to achieve benchmark targets.

These adjustments to the BEA data produced the basic data for the depreciation model.

D. Extrapolation

The BEA data file provides data for the years 1970 through 1985. Since the depreciation model must simulate proposals for 1981 through 1992, the years beyond 1985 were extrapolated in two steps: (a) investment was grown from 1986 through 1992 based on estimated growth rates for each industry from DRI, and (b) the data was subsequently scaled to conform with the Administration's forecast for gross private domestic investment in producers durable equipment, residential structures. and non-residential structures. This extrapolation procedure provides a consistent basic data set that covers the years for which revenue estimates are calculated.

E. Mapping

Mapping of industries and asset classifications is required because BEA industries and asset classifications are not the same as those used by OTA. Since BEA uses more detailed industries than OTA, the 61 BEA industries were mapped into 55 industry classifications used by OTA. ADR mapping also is necessary because not all of the investment attributed to each of BEA's 65 asset types corresponds to one and only one ADR classification. Consequently, the investment in certain asset types are allocated among several different ADR classes depending on the asset type and industry. Investment in other asset types are allocable to one and only one ADR class.

F. The Corporate/Individual Split

The investment data file was split into two separate data files, for the corporate and individual (non-corporate) sectors, so that revenue estimates could be calculated for each sector. The investment data file was split by computing the percentage of total investment by industry that is non-corporate and applying that percentage to the investment in each asset within the industry. This percentage is the weighted sum of the percentage of non-corporate investment in equipment and structures obtained from statistics of income data.

G. Other Data Inputs

Although the adjusted investment data file provides the basic information needed for the computation of tax depreciation, it is incomplete and must be supplemented by data from other sources. For example, it does not contain the amount of investment that received straight line depreciation or sum of the years digits, or the amount of depreciation deductions claimed for the current year or deductions carried forward to future years. The corporate tax model with published corporate statistics of income (SOI) data was used either to extract, or where necessary, generate the additional data in a form that could be used with the investment data. These data include:

- Percent of corporate and non-corporate investment qualifying for bonus depreciation by industry. These amounts are used to determine the amount of corporate and non-corporate investment that is expensed, respectively.
- Growth factors to inflate or deflate expensing and bonus depreciation. These data are used to estimate real growth in the number of businesses by industry and year.
- Depreciation deductions on structures "in place" as of 1981 estimated through 1992 for each industry. These amounts are added to new depreciation to yield total depreciation.

- Depreciation deductions on equipment "in place" as of 1981 estimated through 1992 for each industry. These amounts are added to new depreciation to yield total depreciation.
- Interpolation parameters (by percent change in depreciation) by industry for the a) effective tax rate; b) percentage of depreciation deductions in net operating losses (NOL); and c) ratio of tentative ITC to claimed ITC.
- Percentage of carryback and carryforward that apply to the ITC computations.
- Percentage of NOLs carried back and forward that apply to the depreciation computations.

These additional data complete the input data used in the current version of the depreciation model.

IV. A DESCRIPTION OF THE SIMULATION MODEL

This section summarizes the operation of the depreciation model program. The first subsection highlights the functional operation of the model. A subsection follows that provides a more detailed explanation of selected computations. The last subsection illustrates how the depreciation model is used with other modeling systems to expand the capabilities of those systems.

A. The Simulation Process

The data for each asset in each industry is processed for each year in the simulation for present law (Plan X) and proposed law (Plan Y). For each plan, the model computes by year an investment tax credit and depreciation deductions by proceeding through the following steps:

- The asset tax classification is determined.
- Transition rules are applied, if applicable.
- Expensing is computed and, if appropriate, the expensed amount is subtracted from the cost of property to obtain the adjusted basis.
- The allowable investment tax credit is computed and, if appropriate, the adjusted basis is modified again.
- Regular depreciation deductions are computed for investment that does not receive straight line.
- Straight-line depreciation deductions are computed for investment that is eligible for and chooses to use straight line.

The results are summed for each industry across all asset classifications to obtain total investment, total depreciation, and total "tentative" investment tax credit for the industry by year.

Next, the difference between present law and proposed law depreciation deductions and ITC and the corresponding difference in calendar year tax liabilities and fiscal year receipts are computed. (These computations are described in greater detail later in the subsection on credit computations.) The industry results are available for the corporate sector, non-corporate sector, and both sectors combined.

B. Explanations of Selected Computations

This section provides detailed explanations of the model's computations for expensing, qualified progress expenditures, tax liability, and tax credits.

1. Expensing

A firm can elect to deduct the cost of property up to some maximum in the year the property is placed into service in lieu of recovering the cost under the depreciation rules currently in effect. Only personal property is eligible for expensing. Because the investment data was collected by industry and expensing rules apply to the firm, a procedure was developed to estimate expensing on a industry basis for both the corporate and non-corporate sectors.

Corporate tax model simulations were performed to determine, by industry, the percentage of cumulative investment less than or equal to expensing limits in $5,000 increments up to $50,000. Similar simulations were also performed using the sole proprietorship file to obtain percentages for the non-corporate sector. These percentages, applied to the investment across an industry in a given sector for a specific expensing limit, yield an estimate of expensing. Based on the results of regressions, allowances were made to expensing for the growth in the number of business over time.

2. Qualified Progress Expenditures

Qualified progress expenditures (QPE) are calculated so that their associated ITC can be computed. By looking ahead in the time series, the amount of investment that will be put in place in the future is distributed backwards through time (the construction period) according to an industry-specific pattern. The industries that are affected by qualified progress expenditures rules are chemical and petroleum refining equipment, coal and non-nuclear power plants, and nuclear power plants.

Table 7.1 provides an example of this estimation method for QPEs for chemical and refining equipment. It is assumed that QPEs in the current year are 34 percent of total investment and that this amount was actually spent over the prior 4 years of the construction period. The pattern of this distribution assumes that 7 percent of the cost occurred one year ago, 20 percent two years ago, 48 percent three years ago, and 25 percent in the first year of the construction (four years ago). Once these computations have been completed, the qualified progress expenditures for each year of the simulation

Table 7.1 **Assumptions Underlying Qualified Progress Expenditures**

	Number of Years Past	Chemical Refining Equipment[a]	Coal and Non-Nuclear Power Plants[a]	Nuclear Power Plants[b]
Construction period		4.00	7.00	11.00
Total QPE as a percent of current year investment		34.00	30.28	30.28
	1	7.00	4.00	16.00
	2	20.00	14.00	14.00
	3	48.00	33.00	12.00
	4	25.00	34.00	12.00
	5		11.00	11.00
	6		3.00	11.00
	7		1.00	12.00
	8			6.00
	9			4.00
	10			1.00
	11			1.00

[a] CONCEPT-5, Oak Ridge National Laboratories, Phase VI Update (1983) Report for the Energy Economic Data Base Program, EEDB-VI, September, 1984.

[b] Based on Energy Information Form 254 and Federal Energy Regulatory Commission Form 1. The data are based on a specific 1120 megawatt pressurized-water reactor unit that is considered to be representative of nuclear units.

are summed so that the series will be available for the computation of the investment tax credit.

The same procedure is applied to the other eligible industries. Since the construction period for nuclear power plants is 11 years, the computations cover the period 1971 (1982, when QPE rules were enacted, minus 11 years) to 2006 (1995, the last year the model estimates, plus 11 years). In years where no actual investment data exists, data was generated by assuming that investment continues to grow at the same rate exhibited by the last two periods of actual data.

3. Tax Computations

For each industry the depreciation model computes the following changes for each year in the simulation:

- Tentative total depreciation,
- Tentative current year depreciation,
- Tentative deductions carried back,
- Tentative deductions carried forward,
- Claimed total depreciation,
- Claimed current year depreciation and deductions carried back,
- Claimed deductions carried forward,

- Outstanding carryforward (NOL).
- Calendar year tax liability, and
- Fiscal year receipts.

To compute these changes, summations are required for total depreciation deductions under present law (Plan X) and under proposed law (Plan Y). The tax calculator begins by computing the tentative change in depreciation as the difference between Plan Y and Plan X depreciation deductions. In-place depreciation for equipment and structures is added to present law depreciation to yield total present law depreciation.

Next, the model computes the percentage change in depreciation deductions with respect to total present law depreciation. Both the percentage change in depreciation deductions and industry classification are used to determine three exogenous tax parameters: (a) the effective corporate tax rate for depreciation deductions, (b) the percent of total depreciation deductions in NOLs, and (c) the ratio of claimed ITC to tentative ITC (used in the computation of tax credits). These tax parameters are used to calculate the change in current year depreciation deductions and to allocate the total depreciation change between current year deductions and additions to carryback and carryforward deductions. Tentative changes are computed in four steps.

First, the tentative change in current year taxable income is computed by multiplying the total change in depreciation deductions by one minus the percent of total depreciation deductions in NOLs. Second, the tentative change in carryback deductions is computed by multiplying the tentative change in NOLs by the percentage of NOLs carried back (obtained from data extracted from the corporate SOI). Third, the tentative change in carryforward deductions is a residual obtained by subtracting the tentative change in carryback deductions from the tentative change in NOLs.

The change in current year taxable income is computed as the sum of the tentative change due to current year depreciation deductions, the tentative change in carryback deductions, and the claimed change in carryforwards from prior years (accumulated during prior years of the simulation). For each year remaining in the simulation, the claimed change in carryforward deductions is computed by multiplying the tentative change in NOLs by the percentage of NOLs carried forward. These carryforwards are accumulated for each year remaining in the simulation so that claimed carryforwards will already be computed when the simulation reaches a future year.

Calendar year tax liabilities are computed by sector because effective tax rates differ by sector. The effective corporate tax rates are adjusted for the rate reductions enacted in the Tax Reform Act of 1986 by simple proportional adjustment. Thus, the corporate tax rate (derived from corporate tax model simulations) is multiplied by (0.40/0.46) for 1987 and by (0.34/0.46) for 1988 and the years that follow. The individual tax rates are computed as a base rate adjusted to reflect bracket creep that existed prior to indexing enacted under the Deficit Reduction Act. In addition, the individual tax rates were adjusted further to capture the rate reductions enacted by the Economic Recovery Tax Act. Changes in tax liabilities are then computed by multiplying the change in deductions claimed by the effective tax rate for the appropriate sector.

4. Credit Computations

Following the tax computations, the depreciation model computes the ITC for each year in the simulation. The model computes the following changes:

- Tentative total ITC,
- Tentative current year ITC,
- Tentative ITC carried back,
- Tentative ITC carried forward,
- Claimed total ITC,
- Claimed current year and carryback ITC,
- Claimed ITC carried forward,
- Outstanding carryforward,
- Calendar year tax liability, and
- Fiscal year receipts.

The procedure for these calculations is similar to that for the tax computations for changes in depreciation. Consequently, it will not be discussed further here except to note two differences. First, the allocation of tentative total ITC to carryforward and carryback credits is more complicated than the same computation for depreciation deductions because the model must account for the fact that a change in gross tax will change ITC carried back or forward. In other words, if the ITC does not change between present and proposed law but depreciation deductions do change, then more or less ITC will be carried back or forward. Second, the tax liability computation is different because ITCs are applied directly against tax.

C. Relationship to Other Models

1. Corporate Model

The depreciation model is used to supply three categories of data to assist simulations made with the corporate model: (a) estimates that adjust depreciation deductions by industry on the corporate SOI file, (b) computations of preference amounts that are allocated to corporate returns for computing the alternative minimum tax, and (c) estimates that are used to construct an earnings and profit (E&P) net depreciation adjustment for 1990 and beyond.

For the regular tax, depreciation in the corporate tax model is recomputed by multiplying the base year depreciation by an adjustment ratio. This ratio is the target depreciation, as estimated by the depreciation model, divided by the total base year depreciation on the corporate data base.

For the alternative minimum tax under the Tax Reform Act (TRA), two simulations using the depreciation model are required to produce the appropriate estimates. The first simulation yields depreciation claimed under the TRA for assets put in place after the law becomes effective; the second simulation produces the minimum depreciation generated by these assets.

The adjustment for earnings and profit depreciation requires a series of depreciation model simulations to capture the nuances of the interactions of book income and taxable income within the depreciation system.

2. Supplemental Model

The results of the depreciation model are adjusted using a supplemental model to take into account changes in the tax treatment of research and development property. The adjustment provided by this model is described in detail in section V.B.

V. RESULTS OF SIMULATING THE EFFECTS OF TAX REFORM

This section discusses one use of the depreciation model: determining the revenue effects of changes in depreciation allowances and investment tax credits in the Tax Reform Act of 1986.

A. Simulation Results

The depreciation model evaluated reform proposals in the following order: repeal of the investment tax credit, reduction in existing investment credits, changes in expensing, and changes in depreciation. The order of consideration affects the revenue estimate for a particular provision. For example, the revenue estimate for changes in expensing is different if it is considered before rather than after depreciation provisions. The "stacking order" followed for the Tax Reform Act estimates was statutory tax rate reduction first, followed by investment credit repeal, reduction in existing credits, increase in expensing, and depreciation changes. Stacking order issues are discussed in Nester "Interpreting Revenue Estimates: Macro-Static Micro-Dynamic" in Chapter 1 of this volume. The effect of general rate reduction, which is considered before depreciation and investment credit provisions for revenue estimating purposes, is not discussed here. In addition, the effect of other provisions which were stacked later, such as the minimum tax, are not described here.

1. Summary

The revenue estimates produced by the depreciation model after adjustments are summarized in Table 7.2. The tax reform changes in the ITC and depreciation increase calender year tax liabilities by $260 billion through

Table 7.2 **Revenue Changes From The Capital Cost Recovery Provisions in The Tax Reform Act of 1986, 1986 – 1992***

	1986	1987	1988	1989	1990	1991	1992	1986-1992
	($ Millions)							
Individual	3,320	3,802	5,332	6,729	9,080	11,807	13,138	53,208
Corporate	10,533	15,069	22,408	29,452	36,880	46,254	46,358	206,954
Total	13,853	18,870	27,741	36,181	45,961	58,062	59,496	260,163

*These estimates may differ from other published estimates, because they are based on a different economic forecast and include only selected capital cost recovery provisions.

calendar 1992. Calendar year liabilities increase from $13.9 billion in 1986 to $59.5 billion in 1992 as transition provisions phase out, the economy grows, and a larger fraction of investment becomes eligible for the new depreciation schedules.

The change considered first, investment credit repeal, provides revenue increases roughly proportional to investment in equipment. The changes considered second and third, the reduction in existing credits and increases in expensing, have relatively small effects concentrated in the early years. Depreciation provisions, which were considered last, first reduce and then increase revenue after a few years as the revenue increase from the less rapid depreciation schedules for structures overtakes the revenue loss from the more rapid depreciation schedules for equipment.

Results of the depreciation model are adjusted to produce the final set of revenue estimates. These adjustments take into account current data for the 35 percent cutback of ITCs, the elective 15 year carryback for certain taxpayers, the treatment of R&D property, and recapture provisions for auto and truck leasing. These adjustments are necessary to produce a final set of revenue estimates for the tax reform proposals. Several adjustments made using the supplemental model are described in section B.

2. Investment Credit Repeal

The first change evaluated by the model is repeal of the investment tax credit. Tentative investment credits before reform are calculated according to the classification of the asset. Three-year property receives a 6 percent investment credit and longer lived personal property receives a 10 percent credit unless the property is expensed.

The translation of tentative credit changes to actual tax changes requires adjustments for the interaction of credits with depreciation and adjustments for restrictions on the use of credits and deductions. The computation of revenue changes associated with repeal of the investment credit is described in more detail below.

The baseline investment series for 3, 5, 10, and 15 year personal property eligible for the credit under prior law for calendar years 1986 through 1992 is shown on Table 7.3. Within each asset class the amount of investment is shown that is adjusted in basis for investment credits, is expensed, is allowed ACRS depreciation, and selects straight-line depreciation. Investment expenditures fall primarily in the 5 and 19 year classes. For 1986, $284 billion or 49 percent of investment was accounted for by 5 year equipment. Buildings, which received a 19 year depreciation period, accounted for $153 billion or 27 percent of total investment. Based on the estimates of investment shown on Table 7.3, the model calculates tentative depreciation deductions before repeal of the investment credit. These estimates for calendar years 1986 through 1992 are shown on Table 7.4.

Table 7.5 summarizes the computation of actual tax changes from repeal of the investment credit and shows the total change in calender year liabilities and fiscal year receipts. These totals include various interactions between credits, depreciation allowances and the other tax provisions shown on the table. After a presentation of total investment for reference in lines 1 to 3 of Table 7.5 and total tentative depreciation deductions in the base and revised cases in lines 4 and 5, respectively, the differences in tentative depreciation deductions from repeal of the ITC are presented in line 6. Tentative depreciation deductions increase by approximately $16 billion per year by 1992 from the elimination of the basis adjustment.

Based on simulations of the corporate tax model, the tentative depreciation allowance change is divided into three parts: the portion used in the current year, the portion carried back to one of the previous three tax years, and the portion carried forward to future years. Because some deductions not usable against current year tax liability (carrybacks) are assumed to reduce tax liability for a prior year, any permissible reduction in prior year tax liability from the carryback is a reduction in tax liability affecting Federal government revenue for the current year. These current and carryback deductions from lines 7 and 8 are totaled in line 11. The third portion of depreciation deductions, the position that cannot be used currently or carried back to a prior year due to inadequate tax liability, is carried forward to a future year, perhaps to be usable later as a carryforward (line 9).

Line 12 takes into account the stock of net operating loss carryforwards that some firms have from the past that are usable in the current year. Thus, the current year change shown in line 10 is the sum of current and carryback use of currently earned tentative depreciation deductions plus the amount of carryforwards from previous years used in the current year. The change in the stock of outstanding carryforwards of net operating losses maintained by the model is presented in line 13.

The "bottom line" effect on tax receipts of depreciation related changes induced by repeal of the investment credit is presented in line 14 by calendar year and in line 15 by fiscal year. The tax rate applicable to depreciation allowances is calculated by the model from the basic statutory rates of 40

Table 7.3 Total Investment by ACRS Depreciation Class Before TRA 86, 1986-1992

ACRS Class	1986	1987	1988	1989	1990	1991	1992
			($ Millions)				
3 Year Personal Property							
Basis Adjustment	1,319	1,460	1,638	1,928	2,156	2,341	2,546
Expensing	1,606	1,616	2,466	2,652	3,268	3,273	3,288
Regular	63,187	69,711	78,161	91,889	102,739	111,542	121,252
Straight Line	2,292	2,528	2,835	3,333	3,726	4,046	4,398
5 Year Personal Property							
Basis Adjustment	7,834	8,807	9,934	11,634	13,071	14,353	15,282
Expensing	6,039	6,187	9,461	10,144	12,596	12,843	13,129
Regular	260,463	292,510	329,779	387,067	436,020	480,215	529,839
Straight Line	9,447	10,609	11,961	14,039	15,814	17,417	19,217
10 Year Personal Property							
Basis Adjustment	296	328	366	412	451	489	207
Expensing	10	10	15	16	19	19	20
Regular	11,012	11,801	12,784	14,037	15,174	16,352	18,099
Straight Line	399	428	465	509	550	593	656
15 Year Personal Property							
Basis Adjustment	813	908	1,011	1,160	1,282	1,378	959
Expensing	12	12	19	20	24	24	25
Regular	27,426	30,033	33,240	38,090	42,068	45,238	49,617
Straight line	995	1,089	1,206	1,382	1,526	1,641	1,800
15 Year Real Property Except Low Income							
Basis Adjustment	95	0	0	0	0	0	0
Expensing	0	0	0	0	0	0	0
Regular	11,967	0	0	0	0	0	0
Straight Line	8,974	0	0	0	0	0	0
15 Year Real Property Low Income							
Basis Adjustment	0	0	0	0	0	0	0
Expensing	0	0	0	0	0	0	0
Regular	6,737	7,483	8,282	9,015	9,708	10,582	11,520
Straight Line	237	264	292	318	342	373	406
19 Year Real Property							
Basis Adjustment	0	0	0	0	0	0	0
Expensing	0	0	0	0	0	0	0
Regular	88,335	110,392	122,234	133,177	144,435	157,944	172,574
Straight Line	64,758	80,633	89,173	97,077	105,453	115,342	126,089
Total	574,254	636,809	715,320	817,898	910,419	996,004	1,090,932

Table 7.4 Total Deductions by ACRS Depreciation Class Before TRA 86, 1986-1992

ACRS Class	1986	1987	1988	1989	1990	1991	1992
			($ Millions)				
3 Year Personal Property	56,162	57,518	62,340	70,327	80,411	89,722	97,899
5 Year Personal Property	242,233	257,821	285,559	315,311	354,163	399,006	447,296
10 Year Personal Property	5,899	7,077	8,335	9,730	11,250	12,100	13,144
15 Year Personal Property	10,146	12,255	14,575	17,206	20,200	23,392	26,841
15 Year Real Property Except Low Income	37,566	35,259	32,505	30,301	28,679	27,084	25,721
15 Year Real Property Low Income	2,669	3,222	3,793	4,402	5,033	5,699	6,416
19 Year Real Property	15,614	27,554	40,859	54,700	68,996	83,878	99,617
Total	370,290	400,706	447,966	501,977	568,732	640,881	716,933

percent in 1987 and 34 percent thereafter with adjustments to these statutory tax rates calculated within the model based on the results of simulations of the corporate model. Fiscal year receipts are calculated from the calendar year figures from a rule of thumb division of calendar year liabilities between fiscal years. All amounts are calculated for the corporate and non-corporate sectors separately and aggregated to the totals presented. A similar set of calculations is then performed by the model for investment credit changes, shown starting on line 16. The difference between baseline and tax reform tentative investment credits in lines 16 and 17 is presented in line 18 as the tentative change. The portions of the tentative change used in the current year or carried back to one of the previous three years shown in lines 19 and 20 are summed in line 23. The portion of the outstanding investment credit carried forward from previous years shown in line 24 is added to determine the actual change in line 22. The stock of outstanding carryforward is adjusted for the difference between past carryforward used or lost and current year additions to the carryforward in line 25. Changes in fiscal year receipts in line 27 are calculated from calendar year receipts in line 26.

The total change in line 28 is the sum of depreciation induced changes in tax liability in line 14 and investment credit changes in tax liability in line 26. Similar sums are calculated for fiscal year receipts in lines 15, 27, and 29. The total tentative revenue change in investment credits through 1992 of $337 billion becomes a $230 billion dollar change after carryforwards, carrybacks and associated depreciation adjustments. These are the amounts associated with repeal of the investment credit before the reduction in investment credits that will be discussed next.

3. Reduction in Investment Credits

The second set of tax reform changes evaluated by the depreciation model is the reduction in investment credits allowed. Investment credits allowed under

Table 7.5 **Summary of the Effects of the Proposal to Repeal the Investment Tax Credit of TRA 86, 1986-1992***

	1986	1987	1988	1989	1990	1991	1992
			($ Millions)				
Investment							
1 Total	574,254	636,809	715,320	817,898	910,419	996,004	1,090,932
2 New	494,894	551,343	618,800	707,067	783,012	849,835	924,278
3 Used	79,360	85,466	96,520	110,831	127,407	146,170	166,653
Depreciation							
4 Tentative Plan X (ACRS)	370,290	400,706	447,966	501,977	568,733	640,881	716,933
5 Tentative Plan Y (Repeal)	371,940	404,797	454,406	510,939	580,531	654,835	732,674
6 Tentative Change	1,650	4,091	6,440	8,962	11,799	13,954	15,742
7 Current Year	966	2,466	3,974	5,624	7,473	8,939	10,144
8 Carryback	185	439	666	9012	1,168	1,354	1,511
9 Carryforward	499	1,186	1,800	2,437	3,158	3,661	4,086
10 Actual Change	1,151	2,939	4,756	6,763	9,047	10,915	12,528
11 Current Year + Carryback	1,151	2,905	4,640	6,525	8,641	10,293	11,655
12 Carryforward Used	0	34	115	239	406	622	873
13 Outstanding Carryforward (NOL)	499	1,651	3,336	5,534	8,286	11,325	14,538
14 Calender Year Tax Liability	-408	-957	-1,352	-1,872	-2,514	-3,046	-3,506
15 Fiscal Year Receipts	-218	-699	-1,168	-1,643	-2,222	-2,806	-3,297
Investment Tax Credit							
16 Tentative ITC Plan	36,124	40,405	45,353	52,635	58,873	64,508	63,368
17 Tentative ITC Plan	12,110	6,057	3,608	1,322	1,119	0	0
18 Tentative Change	-24,013	-34,348	-41,746	-51,313	-57,754	-64,508	-63,368
19 Current Year	-15,155	-21,824	-26,791	-33,219	-37,486	-42,222	-41,110
20 Carryback	-443	-626	-748	-905	-1,013	-1,114	-1,113
21 Carryforward	-8,415	-11,898	-14,207	-17,189	-19,255	-21,171	-21,145
22 Actual Change	-15,598	-24,665	-32,530	-41,201	-47,874	-54,578	-55,034
23 Current Year + Carryback	-15,598	-22,450	-27,539	-34,124	-38,499	-43,336	-42,223
24 Carryforward Used	0	-2,215	-4,991	-7,077	-9,374	-11,242	-12,811
25 Outstanding Carryforward (ITC)	-8,415	-18,098	-27,314	-37,426	-47,306	-57,235	-65,569
26 Calender Year Tax Liability	14,540	23,021	29,671	36,734	42,694	48,766	48,641
27 Fiscal Year Receipts	7,937	19,194	26,796	3,747	40,055	46,110	48,484
Total Change							
28 Calender Year Tax Liability	14,132	22,064	28,319	34,862	40,181	45,720	45,135
29 Fiscal Year Receipts	0	26,213	25,628	32,103	37,833	43,304	45,187

*These estimates may differ from other published estimates because they are based on a different economic forecast.

transition rules or carried forward from previous years could be used in full in 1986, but were scaled back 17.5 percent for 1987 and 35 percent for 1988 and thereafter. Marginal revenue changes from this provision are calculated by taking the difference between depreciation model runs that add the investment credit cutback provision to the investment credit repeal provision discussed above and the depreciation model run for investment credit repeal alone. This difference is concentrated in calendar years 1987 through 1990 when unused credits are their maximum and some investment credits are being earned on transition property.

4. Increase in Expensing

The Tax Reform Act of 1986 increases expensing of personal property to $10,000 in 1987; under pre-reform law the increase phases in over a 4 year period. The Act also limits the amount eligible to be expensed to taxable income derived form the active trade or business in which the property is used and phases out the ceiling dollar for dollar on taxpayer investment in excess of $200,000. The revenue cost of this provision totals about $5 billion as shown in Table 7.6, concentrated in the early years when current law allows expensing of only $5,000 or $7,500.

Because limitations on expensing take place at the firm rather than industry level, adjustments to the depreciation model for these changes are based on simulations of the corporate tax model to obtain "rules of thumb" cutbacks to apply to expensing.

5. Depreciation Changes

As described in Section II, TRA completely changed the tax treatment of depreciable assets. The ADR system classified assets by their average useful

Table 7.6 **Revenue Estimates for Expensing Provision Changes in TRA86***

	1987	1988	1989	1990	1991	1992	1986-1992
Calendar Year Liability							
Individual	-1,161	-586	-393	-123	5	-48	-2,306
Corporate	-1,386	-641	-487	-148	7	-62	-2,717
Total	-2,547	-1,227	-880	-270	12	-110	-5,023
Fiscal Year Receipts							
Individual	-436	-946	-514	-292	-75	-15	-2,276
Corporate	-831	-939	-549	-283	-55	-35	-2,692
Total	-1,267	-1,885	-1.062	-575	-130	-49	-4,968

*These estimates may differ from other published estimates because they are based on a different economic forecast.

life in the hands of the purchaser. Most equipment was classified as 5-year ACRS property under pre-reform law. The Tax Reform Act moves this property primarily into the 5 and 7 year double declining balance classes. Thus, most personal property obtains approximately equal or more rapid depreciation from the tax change because 5-year ACRS depreciation is approximately equivalent to 150 percent declining balance (all with an optimum switch to the straight-line method). The depreciation lives of structures are lengthened from 19 to 27.5 or 31.5 years and their depreciation is reduced from the 175 percent declining balance method to straight line.

The amount of investment in each of the eight new classes is given in Table 7.7 for calendar years 1986 through 1992 using the Administration's August 1986 forecast. The distribution of investment by the new depreciation categories is most clearly seen in 1991 and 1992 when transition treatments have ended. (Transition property is shown as an aggregate rather than by class at the bottom of Table 7.7.) The largest class is 5 year property. The next two largest classes are the real property classes for residential and nonresidential building followed by the 7 year personal property class as the fourth largest investment category.

Total deductions for each class by calendar year are presented in Table 7.8. These deductions when adjusted and converted to tax changes are compared with pre-reform law to obtain the summary of differences in Table 7.9 for the depreciation changes alone.

Table 7.9 shows the effect of two factors on revenue changes associated with depreciation provisions in the Tax Reform Act. First, the more rapid depreciation method for most equipment combined with the large amount of investment in the 5 year class produce a revenue loss for 1987 and 1988 as well as for 1986 (when the new schedules were optional for the last five

Table 7.7 **Total Investment by TRA 86 Depreciation Class, 1986-1992**

Depreciation Class	1986	1987	1988	1989	1990	1991	1992
			($ Millions)				
Class 1 (3 year)	40,355	13,663	15,389	17,933	20,042	21,609	23,368
Class 2 (5 year)	207,128	240,314	288,544	353,903	398,487	436,010	477,113
Class 3 (7 year)	2,317	86,299	110,717	141,709	160,903	177,601	196,606
Class 4 (10 year)	11,580	5,168	6,563	8,209	9,023	9,829	10,769
Class 5 (15 year)	56,351	22,521	29,780	37,020	44,196	65,340	70,989
Class 6 (20 year)	4,924	860	1,020	1,155	1,273	1,376	1,486
Class 7 (27.5 year)	45,110	67,252	75,920	82,793	89,301	97,494	106,293
Class 8 (31.5 year)	0	98,307	124,744	147,032	168,550	186,746	204,306
Transition	206,490	102,425	62,642	28,143	18,645	0	0
Total	574,254	636,809	715,320	817,898	910,419	996,004	1,090,932

Table 7.8 Total Depreciation Deductions by TRA 86 Depreciation Class, 1986-1992

Depreciation Class	1986	1987	1988	1989	1990	1991	1992
		($ Millions)					
Class 1 (3 year)	49,630	34,429	20,619	14,776	17,369	19,225	20,917
Class 2 (5 year)	234,107	257,076	281,379	293,319	298,512	325,573	370,567
Class 3 (7 year)	5,174	21,191	44,778	69,757	94,397	116,204	138,841
Class 4 (10 year)	9,306	9,577	9,882	10,479	11,325	12,150	13,082
Class 5 (15 year)	39,319	39,682	39,176	39,698	41,223	43,867	47,620
Class 6 (20 year)	2,541	2,529	2,249	2,020	1,875	1,777	1,731
Class 7 (27.5 year)	11,545	13,672	15,362	17,379	19,663	22,215	25,162
Class 8 (31.5 year)	0	1,560	5,083	9,341	14,246	19,717	25,676
Prior Year & Transition	21,280	41,679	49,327	50,004	50,695	31,581	20,733
Total	372,902	421,396	467,854	506,773	549,303	592,308	664,328

Table 7.9 Revenue Estimates for Depreciation Schedule Changes in TRA 86, 1986-1992*

	1986	1987	1988	1989	1990	1991	1992
		($ Millions)					
Calendar Year Liability							
Individual	-84	-335	-362	573	1,830	3,463	3,908
Corporate	-312	-1,356	-2,126	-77	3,448	8,672	9,879
Total	-396	-1,692	-2,487	497	5,278	12,135	13,787
Fiscal Year Receipts							
Individual	0	-210	-345	-11	1,045	2,443	3,630
Corporate	0	-1,126	-1,818	-896	2,038	6,583	9,396
Total	0	-1,336	-2,163	-907	3,083	9,025	13,026

*These estimates may differ from other published estimates because they are based on a different economic forecast and include only selected capital cost recovery provisions.

months). These revenue losses total about $4.6 billion for the three calendar year period. These effects dissipate with time as smaller depreciation deductions in later years offset faster deductions in earlier years. Second, the large investment category of structures that receive smaller annual depreciation allowances under the Act increase revenue enough over a few years to dominate the revenue reductions on equipment. The revenue loss becomes a half billion dollar gain in 1989 which increases to over $5 billion in 1990. The total estimated revenue gain from the depreciation provisions exceeds $20 billion over the seven year period.

The combined effect of all depreciation and investment credit changes calculated by the depreciation model is presented in Table 7.10 The dominant effect of the repeal of the investment credit insures a revenue gain in all years despite early period losses from increased expensing and depreciation allowances for many assets. These estimated revenue increases total about $231 billion using the post reform statutory tax rates. The Tax Reform Act lowered statutory tax rates which offsets much of this revenue increase.

B. Adjustments to Depreciation Model Results

Four adjustments to the results from the depreciation model produce the final set of revenue estimates. The first adjustment concerns the 35 percent cutback of investment credit carryforwards which are phased in over a two-year period. To estimate the effects of the reduction, more recent historical data than are contained in the depreciation model were used to determine the amount of unused investment credits available for carryforward at the end of 1985. Separate more refined estimates, including results from the Treasury corporate tax model, were used to determine the pattern of carryover usage, and the extent to which the reduction would restrict credit usage.

Adjustments were also made to the results for the elective 15-year carryback for certain taxpayers, in particular, certain steel companies and qualified farmers. The corporate and individual tax models and an analysis of specific tax returns were used to determine the amount of ITC's affected by the provision, and the extent to which individuals and corporations would be able to utilize the carryback option.

The third adjustment accounts for the tax treatment of equipment used for research and development (R&D) purposes. Under pre-reform law R&D equipment investments were depreciated as three year property. Under tax reform these investments are treated as five year property. Because the depreciation model does not separately identify investment for R&D purposes, it cannot provide estimates that adequately reflect changes in tax depreciation rules that apply to this use of investment. A supplemental model was employed to obtain an estimate of the change in revenue from the altered treatment of R&D,

Table 7.10 **Summary of the Revenue Changes Associated with Capital Cost Recovery Provisions of TRA 86, 1986-1992***

	1986	1987	1988	1989	1990	1991	1992
		($ Millions)					
Calender Year Tax liability	13,853	18,870	27,741	36,181	45,961	58,062	59,496
Fiscal Year Receipts	0	23,997	23,886	30,617	41,490	52,592	58,615

*These estimates may differ from other published estimates because they are based on a different economic forecast and include only selected capital cost recovery provisions.

which is added to the results of the depreciation model. A forecast of investment in R&D property is depreciated according to both pre-reform and reform rules. A marginal tax rate is applied to the difference in annual depreciation deductions and the resulting tax change added to the model results for depreciation-related revenue changes. These adjustments add approximately $4 to $5 billion to revenue through 1992.

This adjustment is an approximation because information on the distribution of tax lives of R&D property is not available. Under pre-reform law almost all R&D equipment would be classified as 5 year ACRS property in the depreciation model. Under post-reform tax rules most R&D investment would be classified as 5 year property (computers and high technology instruments) and a smaller portion would be classified as 7 year (or longer lived) property. On average it is assumed that because of the faster depreciation method under reform (200 percent declining balance versus 150 percent) tax depreciation would not be substantially slower (or faster) under reform than before in the absence of special treatment of R&D property. Thus, no net revenue increase would be shown in the depreciation model from the change in tax treatment of R&D property. The supplemental model calculation then approximately adjusts revenue for the change in R&D equipment depreciation rules. If all R&D property under the new rules is 5-year property the adjustment understates the additional revenue from longer tax lives on R&D equipment.

The fourth adjustment is for auto and truck leasing. Although the depreciation model makes some provision for the retirement of assets or sales to non-business sectors, it does not adjust depreciation allowances for recapture of excess depreciation when an asset is sold on the difference between the sale price of assets and the depreciable basis. Recapture increases revenue when depreciation schedules overstate depreciation and reduces revenue when depreciation is understated. In effect, recapture adjusts depreciation allowances to the correct total amount (neglecting inflation) when the asset is sold.

The Tax Reform Act changes the depreciation schedule for autos and light trucks from 3 years, which would generally overstate depreciation, to 5 years. The depreciation method also is changed from approximately 150 percent declining balance to 200 percent declining balance (with an optimal switch to straight line). For automobile and truck leasing, where the holding period is short in many cases and assets are often systematically resold, an adjustment is made to the depreciation model results for recapture. The series for investment in autos and trucks are divided into a leased fraction subject to depreciation recapture. Proportions of auto and truck investments are assumed to be sold each year at a price determined by a depreciation rate, assumed to be 33 percent for autos (Hulten and Wycoff (1981)), and an inflation rate, assumed to be 3 percent over the forecast period. The value of depreciation deductions is calculated twice both assuming no sales and assuming sales distribution patterns for autos and for trucks. The difference between these sale and no sale calculations of $4 billion over the period is subtracted from revenue estimates. The net change from this adjustment is a reduction in the estimated revenue increase in autos and light trucks that would otherwise be calculated for the forecast period from a lengthening of tax depreciation lives.

APPENDIX

Table 7.11 compares depreciation systems under prior law and the Tax Reform Act of 1986.

Table 7.11 **Comparison of Depreciation Systems**

Asset (ADR Midpoint Life or Description)	Pre-Reform Law	Tax Reform Act
2-4	3-yr ACRS	3-yr DDB/SL
R&D equipment (various ADR midpoint lives)	3-yr ACRS	5-yr DDB/SL
Autos & light trucks (3,4)	3-yr ACRS	5-yr DDB/SL
Race horses over 2 years old	3-yr ACRS	3-yr DDB/SL
13-year and older horses	3-yr ACRS	3-yr DDB/SL
4.5-6.5	5-yr ACRS	5-yr DDB/SL
Semi-conductor manufacturing equipment (reassigned to 5-year from 6-year ADR midpoint life)	5-yr ACRS	5-yr DDB/SL
Qualified technological equipment (various and no ADR lives)	5-yr ACRS	5-yr DDB/SL
Renewable energy property (various and no ADR midpoint lives)	5,15-yr ACRS	5-yr DDB/SL
7-9.5		
Rental clothing (9)	5-yr ACRS	5-yr DDB/SL
Computer based central office-switching equipment (reassigned to 9.5 from 18-year ADR midpoint life)	5-yr ACRS	5-yr DDB/SL
10-12.5	5-yr ACRS	7-yr DDB/SL
Breeding and work horses (10)	5-yr ACRS	7-yr DDB/SL
No ADR life personal property	5-yr ACRS	7-yr DDB/SL
Railroad track (assigned 10-year ADR midpoint life)	5-yr ACRS	7-yr DDB/SL
13-15.5 .	5-yr ACRS	7-yr DDB/SL
Railroad tank cars (14-15)	10-yr ACRS	7-yr DDB/SL
Single purpose agricultural structures (reassigned to 15-year from 34-year ADR midpoint life)	5-yr ACRS	7-yr DDB/SL
16-19.5	5-yr ACRS	10-yr DDB/SL
20-24.5	5-yr ACRS	15-yr 150DB/SL
Telephone distribution plant (reassigned 24-year from 35-year ADR midpoint life)	5,15-yr ACRS	15-yr 150DB/SL
Sewage treatment plant (assigned 24 year ADR midpoint life)	5-yr ACRS	15-yr 150DB/SL
25-27	5-yr ACRS	20-yr 150DB/SL
27.5-29.5	5-yr ACRS	20-yr 150DB/SL

Table 7.11 **Comparison (continued)**

Asset (ADR Midpoint Life or Description)	Pre-Reform Law	Tax Reform Act
27.5-29.5 real property	19-yr ACRS	31.5-yr SL
30-35.5	5-yr ACRS	20-yr 150DB/SL
30-35.5 real property	19-yr ACRS	31.5-yr SL
36 and over ADR midpoint life	5-yr ACRS	20-yr 150DB/SL
Sewer pipes (assigned 50-year ADR midpoint life)	15-yr ACRS	20-yr 150DB/SL
36 & over ADR midpoint life real property	19-yr ACRS	31.5-yr SL
Less than 27.5 real property	19-yr ACRS	20-yr 150DB/SL
Residential housing	19-yr ACRS	27.5-yr SL
Low-income housing	15-yr DDB/SL	credit provided
Manufactured homes	10-yr ACRS	10-yr DDB/SL
Public utility property (18.5-24.5)	10-yr ACRS	by ADR life
Public utility property (25+)	15-yr ACRS	20-yr 150DB/SL

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8 THE IMPACT OF THE TAX REFORM ACT OF 1986 ON TRADE AND CAPITAL FLOWS

Harry Grubert and John Mutti

I. INTRODUCTION

The effect of tax reform on the international position of the United States has been the subject of much debate. Some observers have expressed the concern that the United States would become deindustrialized because of a decline in international competitiveness. The direction of the change in capital flows has also been disputed. U.S. commentators have tended to worry about an outflow of capital from the United States because of higher taxes on business. In contrast, observers in other countries, such as Canada, fear a great inflow into the United States from their own countries because of the lower statutory corporate rates.

This paper evaluates the international implications of tax reform using a general equilibrium model with both trade and international capital flows. A general equilibrium model is necessary because it is impossible to judge the change in a particular sector's competitiveness by looking only at its costs, without paying attention also to changes of costs in other industries and to changes in real wages and rates of return. A properly specified general equilibrium model also maintains a consistent relationship between capital flows and the current account. In fact, the dependence of the trade balance on capital flows is one of the major aspects of this analysis, because tax reform has a very modest direct impact on trade in the absence of capital mobility and international investment income.

Before we proceed, it may be helpful to say a word on competitiveness. Unlike conventional old-fashioned terms used in trade theory, such as the terms of trade, welfare, comparative advantage etc., it is not clear what competitiveness is supposed to mean. In most people's minds, it seems to mean the trade (merchandise) balance, but why does one focus on certain kinds of U.S. products to the exclusion of others? Presumably it is the demand for U.S.

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output as a whole that it is at issue. Most discussions of competitiveness seem to assume that if a foreigner buys a U.S. made computer, ships it back to his resident country and leases it there, that is desirable; on the other hand if the foreigner leaves the computer in the United States to be leased here, that is undesirable because it is a capital inflow and not an export. The reverse would appear to be true because the computer stays here to contribute to U.S. productivity. One cannot look at the trade balance alone to evaluate the impact of tax reform on the international economy. But, one must look at the capital account as well; the capital inflow finances both the import surplus and additional capital spending in the United States.[1] Looking at all demands for U.S. resources, both from trade and investment flows, gives a better indication of U.S. welfare.

II. GENERAL OVERVIEW OF MODEL

The simulation model used in this paper was developed by the authors to study the impact of export incentives and the significance of capital mobility in altering the effects of personal and corporate taxation (Mutti and Grubert, 1984a, 1985 and 1986). The purpose of the simulations is to determine the magnitude of price and output changes at a rather broad sectoral level. Other attempts to evaluate the impact of tax reform on trade (International Trade Commission, 1986 and Gravelle, 1986) have used a more detailed array of industries, but they have been essentially partial-equilibrium treatments with an attempt to make a general equilibrium correction through the use of a balance of payments equation. In particular, they overlook the non-traded sector entirely because they assume that consumers only choose between imports and similar competing domestic goods. In addition, they do not explicitly model changes in capital flows, rates of return, real wage rates or real income, but must depend on other analyses to provide information on them. The model in this paper solves simultaneously for the new trade flows, capital flows, real wages, rates of return and relative prices of traded and nontraded goods.

The model used in this paper has two countries: the United States and the rest of the world. Each country produces 4 goods: equipment, a non-equipment net export good (from the U.S. point of view), a non-equipment net import good, and a non-traded good such as housing and services. Each good is produced from varying proportions of three factors: unskilled labor, skilled labor and physical capital. Capital used in each country is in turn a composite made up of domestically produced equipment, foreign-produced equipment, and the nontraded good, with the proportions depending on relative costs.

Domestic output in an industry is not assumed to be perfectly substitutable in consumption with output from the same industry abroad. Consumers in each country therefore choose among the local non-traded good and the 4 traded consumer goods, of which 2 are domestically produced.[2] Similarly, residents in each country can allocate their saving to the acquisition of capital located either at home or abroad. The real growth of capital used in each country thus depends upon savings by both foreign and domestic residents. Although foreign and domestic investment are not regarded as perfect substitutes in portfolios, an increase in after-tax returns in one location relative to another will attract more investment from both foreign and domestic savers. Foreign investment is, therefore, treated as a two-way flow; this pattern may be attributed to the decision of investors to diversify their asset holdings.

The emphasis of the analysis will be on the effect of a policy change on long-run steady state income, trade, and the capital stock. However, the contrast with short-run results will also be noted. This contrast can be significant because, in the short run, any permanent shift in the accumulation of foreign assets does not yet yield significant investment income in relation to the additional expenditure on foreign assets. Any increase in the acquisition of foreign assets must therefore be financed in the short run by an increase of exports relative to imports. In the long run, however, investment income from abroad will increase as a result of the reallocation of assets, and this service flow can reverse the initial export surplus.

We also note that the acquisition price of the composite capital good can be different in the two countries. One reason is that each contains a large component of nontraded goods. In addition, tariffs and export incentives can create differences even in the price of traded goods.

III. SPECIFIC COMPONENTS OF THE MODEL

In order to clarify how taxes enter into the model, it is helpful to describe its basic components:

1. Zero-profit equations for each sector relate producers prices to input requirements and the cost of factor inputs. The cost of capital depends on the net (after personal and corporate tax) rate of return required by resident savers, the price of the capital good, and on the tax at both the corporate and personal level. To illustrate the role of each of these levels of tax, the cost of capital in a country is $P_i/(1-t_c)(1-t_p)$ where P is the price of the capital good in the country, i is the after tax rate of return received by resident savers, and t_c and t_p are the marginal tax rates at the corporate and personal level.

2. Factor utilization equations relate total factor demands to factor supply. Factor demands depend upon relative gross-of tax factor prices, and a reduction in either capital tax variable reduces the desired ratio of labor to capital per unit of output. The size of this adjustment depends importantly upon the relevant partial elasticities of substitution in production. These factor demands are set equal to the factor supplies. Aggregate labor supply is exogenous while the supply of capital depends on endogenous savings decisions.

3. Product demand equations relate total (foreign and domestic) demand for each sector's output to relative prices and income. If there are (tax or non-tax) export incentives, prices paid by foreigners are less than those paid by domestic consumers.

4. Two savings or portfolio equations for residents of each country generate the demand for capital located domestically and abroad. Portfolio demands by savers depend on total income and relative after-tax rates of return. In the case of income from foreign investment, the relevant after-tax return has to be spelled out more explicitly because domestic and foreign investors may face different taxes at the personal level on investment in a particular location. Let i_A represent the percentage return to capital after taxation at both the corporate and personal level that is received by A residents from capital used in A. The return to B residents who own capital assets in A is based on the after-corporate-tax rate of return in A, $i_A/(1-t_p^A)$, which is then reduced by any residual corporate-level tax in B, and finally, by the personal tax paid by B residents on this foreign-source income. (There may also be corporate level foreign withholding taxes in A.) This personal level tax will be basically the normal domestic personal level taxes on that income because foreign withholding taxes tend to be small and are usually credited in the home country. Thus the final after-tax return of B savers who invest in A is $(i_A/(1-t_p^A))(1-t_F^B)(1-t_p^B)$ where t_F^B is the residual corporate-level tax (after credits) in B on foreign investment income. (See Mutti and Grubert (1985) for a discussion of the assumptions on the sectors to which foreign investment flows. The allocation of portfolios is a relevant issue because of sectoral differences in personal taxes. Therefore, t_p^A above is not unique and the particular value relevant for foreign investors has to be specified. If there is only a single sector, then using the above expression for foreign investors' after-tax return from investments in A in order to determine the cost of capital in A yields the same equation as the one given in item 1. That is, the cost of capital is the same irrespective of whether resident or nonresident after-tax returns are used as the starting point.)

5. An income equation for each country defines income as a function of the market value of output, net international investment income and net tariff (or subsidy) collections (or payments). If the United States grants a general export incentive to foreigners, the lower price enjoyed by foreign consumers is financed by lower income available to U.S. residents.

6. There are also two equations which relate annual investment in a country to the stock of capital in the steady state. As previously

noted, the change in nominal investment in A depends upon the saving decisions of both A and B residents. In the steady state framework utilized in this analysis, the rate of growth of the real capital stock for each country must be constant and equal to the sum of exogenous growth of the labor force and Harrod-neutral productivity growth, assumed to be identical in each country. This steady state, equilibrium condition appears as follows for country A:

$$\frac{S_A/P_A}{K_A} = g, \tag{8.1}$$

where S_A/P_A is nominal investment in A divided by the price of capital goods, K_A is the initial capital stock in A, and g is the exogenous steady state rate of growth. The change in the capital stock from one steady state to another is therefore $\hat{K}_A = \hat{S}_A - \hat{P}_A$, where a carat denotes the percentage change in a variable. An analogous equilibrium condition exists for $\hat{K}_B$.

IV. ELEMENTS OF THE TAX REFORM ACT MODELED

A. Changes in Sectoral Tax Rates at the Corporate and Personal Level

The basic simulations include the "standard" changes in domestic taxation usually modeled in studies of the cost of capital, i.e. the reduction in the statutory personal and corporate rates, the elimination of the investment tax credit, the modification of the Accelerated Cost Recovery System (ACRS), and the repeal of the capital gains exclusion. (Supplemental runs in which an attempt is made to include other major items are described below.) The changes in marginal effective tax rates by sector resulting from these "standard" reforms are based on the tax wedge and effective tax rate calculations described in the paper by Fullerton, Gilette and Mackie (1987) in this volume. Estimates on the cost of capital were provided for industries at the two-digit level of detail and these were classified into the four domestic sectors: equipment, non-equipment net export goods, non-equipment import goods, and non-traded goods.[3] Sectoral costs of capital were then calculated using industry capital stocks as weights. The sectoral costs of capital were available for 3 situations: pre-tax reform law, fully phased-in business provisions under the Tax Reform Act but with pre-reform personal taxes, and fully phased-in tax reform. It was therefore possible to divide the percentage change in sectoral cost of capital into the component attributable to changes in personal taxation and to changes in business taxation. This division is necessary in an open economy model because foreign investors do not face the same personal tax rates as domestic investors, and domestic investors can choose to invest in capital which is unaffected by the U.S. corporate tax.

Before discussing the changes in the sectoral tax rates it may be useful to more specific about the composition of the sectors. Equipment includes electrical and nonelectrical machinery, aircraft and instruments. Non-equipment export goods includes most of agriculture, chemicals, and printing and publishing. The import-competing sector includes a large variety of mainly manufacturing industries such as textiles, primary metals and motor vehicles. The large non-traded good sector includes construction, transportation, utilities, finance, services, wholesale and retail trade and housing.

The changes in the sectoral costs of capital are given in Table 8.1. The cost of capital in the import competing sector increases somewhat more than in the other sectors. This is due to the tax changes at the business level and results from the import-competing sector's heavier dependence on types of capital adversely affected by tax reform, particularly equipment. At the personal level, the import-competing sector and the equipment sector have virtually identical changes, because in both sectors activity is almost exclusively in corporate form. The tax increase in these sectors at the personal level results from the increased tax rate on capital gains; it has a large weight because of the significance attributed to retained earnings under the "new view" of dividend taxation adopted by Fullerton, Gillette, and Mackie. The differing personal changes in the other two sectors are due to the greater significance of unincorporated business, such as in agriculture, and in owner-occupied housing in the nontraded sector. Finally, it should be noted that even the largest percentage increase of the cost of capital in Table 8.1, which is in the import-competing sector, is less than 10 percent and translates into a much smaller relative increase in prices once the share of capital in total costs is considered.

Table 8.1 **Changes in Sectoral Tax Rates Resulting from Basic Changes in Domestic Taxation***

	Percent Change in Cost of Capital Due to		
Sector	Business Tax Changes	Personal Tax Changes	Total
Equipment	0.5%	3.7%	4.2%
Non-Equipment net export goods	4.0	-1.3	2.7
Import-competing goods	5.0	3.6	8.6
Non-traded goods	3.9	.8	4.7

*Note that these are changes in percent, not percentage points. They are basically values for the expression dt/1-t, which represents the percentage change in the cost of capital directly attributable to the change in the tax rate.

B. Changes in the U.S. Corporate Tax on International Investment Income

The Internal Revenue Code has various provisions governing the U.S. tax both on foreign income received by U.S. residents and the tax imposed on payments of U.S. income to nonresident investors. The Tax Reform Act made changes applying to both types of income. With respect to foreign income earned by U.S. corporations, there were a number of base-broadening changes, such as the provision on the allocation of interest expense to foreign income, described below, which increase U.S. tax. On the other hand, the reduction of the U.S. statutory corporate rate has an offsetting effect. The tentative U.S. corporate tax on foreign source income is the U.S. statutory rate applied to the foreign income. This is then reduced by the amount of allowable foreign credits. Thus, if the corporation was not initially in an excess foreign tax credit position, a reduction in the U.S. statutory rate reduces the residual U.S. tax.

The impact of these changes in the taxation of foreign income was, however, not estimated in a manner entirely comparable to the Fullerton-Gilette-Mackie calculations for domestic income. The system of taxing corporation foreign income, which involves many specific provisions, has not yet been modeled in a manner parallel to the hypothetical Hall-Jorgenson type of estimation undertaken by Fullerton, Gillette, and Mackie. In principle it would be possible to do so, but it would require starting with hypothetical investments having very specific characteristics. The additional sources of financing foreign investment, not relevant for domestic investment, could also be included. For example, investment abroad can be financed by earnings retained abroad, in particular the earnings of foreign corporations controlled by U.S. taxpayers. Income retained by the domestic parents can also be invested abroad, both in the form of new equity or of new foreign lending. There can also be portfolio investment abroad, either by U.S. individuals or through U.S. corporations. (The most important source of portfolio investment abroad is overseas lending by U.S. banks.)

As indicated, no attempt was made to make these modeling extensions because they would have required a major new study by themselves. Instead, the revenue estimates for the foreign provisions were used. In order to convey the long run impact of the reforms, the version of the revenue estimates employed were the "fully phased-in" changes at 1986 activity levels estimated by the Treasury Department. These fully phased-in estimates give the revenue change after all transition rules have expired and all short-run timing effects no longer play a role.

The fully phased-in estimates for each of the foreign items are given in Table 8.2. They are divided into several categories because some of the provisions apply to investment in the United States and because the provisions vary in how closely they are linked to real investment in a given location. The first grouping applies to investment by U.S. corporations abroad that is

Table 8.2 **Fully-Phased-In Annual Revenue Increase of Foreign Provisions (1986 levels at a 34 percent corporate rate)**

Provision	Revenue Increase (millions of dollars)
1. General Foreign Investment Income	
Separate foreign tax credit limitations	351
Separate limitation for high withholding taxes on interest	1,500
Treatment of losses in foreign tax credit	19
Revision of deemed paid foreign tax credit	71
Allocation of interest expenses to foreign source income	806
Allocation of expenses other than interest and R&D	77
U.S. transportation income of foreign entities	22
Transfers of intangibles abroad	101
2. Foreign Investment in the United States	
Dual residence companies	109
Income of foreign governments	43
3. Financial Investment in Tax Havens	
Expand Subpart F income	155
Revision of de minimis rule for tax haven income	58
Captive insurance Companies	105
Foreign investment companies	15
Use of deficits in E&P	19
4. Other	
Possession credit	59
Memorandum item:	
Total in category (1)	2,947
Reduced tax on foreign source income because of lower statutory corporate rate.	3,243

assumed to be directly linked to real investments there. The most important of these are the new interest allocation rules and the separate foreign tax credit limitation for interest on foreign loans which are subject to high withholding taxes. The first of these will generally require a larger allocation of U.S. interest expense to foreign income because U.S. companies will no longer be able to avoid an allocation by devising an advantageous tier structure for their domestic affiliates. The separate limitation for high withholding interest mainly applies to bank loans to certain countries that impose high gross withholding taxes, which heretofore could be credited to other, lightly-taxed foreign income. It is assumed that these loans lead to higher real investment abroad.

The second category of foreign provisions apply to income from investment by foreigners in the United States. It is used to compute the additional U.S. tax paid by foreigners on their investments in the United States. The provision on dual residence companies applies to U.S. corporations which are also regarded by some jurisdictions as being resident in their own country because of differing definitions of residence. In these situations, it can be consolidated with affiliated companies in both countries. so that any loss can be used twice. The Tax Reform Act restricted this double use of losses. The second item in this category reduces the scope of the tax exemption on investment income received by foreign governments by denying its use for "commercial" activities.

The third grouping involves financial investments of U.S. corporations in tax havens. These are presented separately from the first category because they are anti-conduit (Subpart F) provisions where the ultimate location of the marginal real investment or business being financed may well be the United States. The provisions limiting the benefits of using captive insurance companies are a typical example. The captives are insurance companies organized in certain low-tax locations which insure the U.S. parents' risks. The new provision applies to "group" captives (i.e., those whose business is not restricted to a small number of controlling U.S. companies, and therefore not covered by pre-TRA rules). It requires the current recognition of income from the insurance of U.S. risks. The country-specific risk at issue, and probably the ultimate destination of most of the insurance companies' financial reserves is the United States. It would therefore be incorrect to regard this provision as an increased tax on income from real investments abroad.

The necessity for the rather arbitrary groupings in Table 8.2 is due to the fact that we do not in this paper explicitly model the relationship between real and financial assets. This has been attempted by the authors in the past (Mutti and Grubert, 1984b). but not in the detail required for the present analysis. The main problem is that international portfolios do not seem to obey any logical pattern. such as diversification. so that one cannot have any confidence in behavioral parameters based on standard portfolio models. (See Adler and Dumas, 1983.)

Some of the specific items do not of course fit neatly into a single category. For example, the major component of the separate foreign tax credit limitations in the first category might properly be regarded as principally a tax on passive financial investment income abroad and therefore placed in the third group, as is the closely related provision on Subpart F income. The conceptual problem arises because in these kinds of cases, a tax benefit depends on the interaction of two activities. For example, if a U.S. company received highly-taxed operating income from abroad, any excess credits generated by the income could (before the Tax Reform Act) shield some types of low-tax financial income. Depending on the position of any particular taxpayer, the benefit could be regarded as an incentive on the margin for increased operating investments abroad (if the taxpayer was not in an overall excess credit position) or as an incentive on the margin for passive financial income. The effect of marginal incentives of putting these two types of income in separate foreign-tax-credit-limitation categories will therefore depend on this pre-reform position. (In contrast, reduced opportunities for deferring passive income as a result of new Subpart F provisions always represent increased taxes on financial income).

The provision applying to dual residence companies, referred to earlier, is also problematical. The restrictions on this type of arrangement can affect real investments in either country. Putting it in the second category rather than the first is therefore quite arbitrary.

The quantitative estimate of the impact of tax reform on the U.S. corporate tax on investment abroad is derived by summing the tax increases in the first category in Table 8.2 ($2,947 million) and netting them against the reduction in U.S. tax on foreign corporate income due to the reduction in the statutory rate ($3,243 million).[4] The difference is then divided by total U.S. foreign income to arrive at the change in the tax rate in percentage points. The result of the procedure is a tax reduction of 0.3 percentage points.[5] While this is small, it contrasts with the substantial increase in corporate tax on domestic investment evident in Table 8.1 and in the overall business revenue estimates.

The increased U.S. tax on investment by foreigners in the U.S., over and above the changes that apply to all domestic investment, is derived in a similar fashion, by summing the items in the second group in Table 8.1. There is a very small increase in U.S. tax.

One of the issues in the use of the fully phased-in long run estimates is whether they adequately capture changes in effective tax rates attributable to deferral of taxes. In the long run, the increased deferral of taxes would only affect annual revenue because of growth in income. For example, reduced opportunities for accelerated depreciation will not change tax revenues in the long run stationary steady state even though effective tax rates have clearly risen. However, this problem is not serious in the use of the estimates for the foreign provisions because the most important provisions, related to interest allocation and separate limitations for high-withholding tax interest income, do not have significant deferral or acceleration effects. The use of the fully-phased in estimates, rather than the actual 5 year revenue estimates is intended to reflect the impact of the tax reform after all the transition rules no longer play any role.

Having calculated the change in the corporate level U.S. tax on foreign income, we are now faced with the question as to its role in the analysis. Some discussions of the residual U.S. corporate tax on foreign income seem to regard it as a tax on investment in the United States, i.e. the tax constitutes a barrier to repatriating foreign income and investing it in the United States. They therefore expect an increase in repatriations and presumably greater U.S. investment as a result of the TRA. However, David Hartman's analysis of dividend repatriation decisions is an effective refutation of this view. (See Hartman, 1984, and references therein.) Hartman has in a series of papers expressed the position that the residual U.S. tax on dividend repatriations is irrelevant for the choice of investments to be financed out of foreign earnings. The reason is that the tax has to be paid sooner or later. This parallels the "new view" of the taxation of dividends in the domestic context that is embodied in the Fullerton-Gilette-Mackie effective tax rate estimates. The Hartman analysis thus concludes that only the after-foreign-tax return on investments abroad and the U.S. after-tax return on competing domestic investment is relevant for dividend repatriation decision.

The Hartman argument should, however, not be pushed too far. It applies only to dividend repatriations and not to the U.S. tax on other types of foreign income. These types of income are significant and play an important role in the estimation of the change in overall U.S. corporate taxes on foreign income. Statistics of Income (SOI) tabulations for 1982 indicate that dividend income only accounts for about 30.0 percent of foreign source gross income. (See SOI Bulletin, Spring, 1986.) There is substantial interest income, largely to U.S. banks, and because it is lightly taxed, this income is a major beneficiary of the statutory rate reduction. In addition, rents, royalties and service income are almost as significant as dividends. They represent income from investment abroad not in the form of corporate equity and therefore there is no opportunity for retaining it abroad. Any change in U.S. tax on this income is therefore a change in the tax on marginal foreign investment in this non-equity form.

Another way of looking at this issue is to examine the financing sources for U.S. investment abroad. Retained earnings have not been the dominant source in recent years. For example, in the 7 years from 1979 through 1985, earnings retained abroad by incorporated affiliates accounted for 21.7 percent of all private gross U.S. capital outflows. Claims reported by banks, which presumably are bank loans, accounted for 72.6 percent of all private outflows for the period.

In view of these considerations, no adjustment is made to reflect the Hartman argument. The small magnitude of the change in the U.S. corporate tax on foreign income makes the issue largely moot in any case.

The above discussion of funding sources for U.S. foreign investment is also relevant for the evaluation of the change in the personal-level tax on marginal foreign income. The Fullerton-Gilette-Mackie estimates for domestic investment used in Table 8.1 assume that retained earnings account for 61.4 percent of any marginal investment. In view of the significance of debt flows abroad (of which only a small percentage could represent loans of the banks' own equity capital), the share of retained earnings is assumed to be 40.0 percent, instead of the 61.4 percent used in the domestic context, with debt accounting for 50.0 percent and new equity the remaining 10.0 percent. The financing share attributed to debt is conservative in view of the role of debt in capital flows cited above. Because the risk characteristics of foreign investments may be different from domestic investments (e.g. assessing an equity investment abroad may be much more difficult), it is not illogical to assume different financing shares for domestic and foreign investment.

The version of the model used in this paper does not distinguish between portfolio and direct investment abroad; that is, there is no distinction between locally-controlled or foreign-controlled production in a country. But, for the purposes of the current exercise, this fact does not seriously restrict the responses that are captured. Any increases or decreases in relative sectoral costs in the United States because of tax changes, and the resulting redistribution of trade, is reflected. The main advantage of a more detailed characterization of capital flows would be the ability to use U.S. tax rates for investment abroad in specific sectors. That is, while the average U.S. corporate tax rate on foreign investment income barely changes, it may change substantially for some sectors, e.g., U.S.-controlled manufacturing. Any significant effect of this type seems unlikely, however. The reduction of the U.S. statutory rates to 34 percent only reduces the U.S. tax on foreign manufacturing income by about 4.0 percentage points and the significant revenue raisers such as interest allocation would narrow the reduction to perhaps 2.0 percentage points or less. The impact of this change would be further diluted because U.S.-controlled manufacturing abroad is only one of the (and in most cases a relatively insignificant) sources of U.S. manufacturing imports (or competition for domestically produced exports).

C. Changes in Specific Tax Provisions Directed at Exports

Exports can be affected because changes in domestic taxation change costs in the export sector relative to costs in other domestic sectors. In addition, there are specific tax provisions that apply specifically to export income and reduce the price of U.S. produced goods to foreigners for any given level of domestic costs. One of these provisions is the Foreign Sales Corporation (FSC) rules that exempt from U.S. tax the portion of export income attributable (by either administrative pricing rules or actual arm's-length prices) to marketing activities by the offshore FSC. This generally results in an exemption from tax of 15 percent of the total corporate income from FSC exports. Because the value of the provision to exporters depends upon the statutory tax rate, the reduction of the corporate rates from 46 to 34 percent reduces the effective FSC benefit. Specifically, Treasury data indicate that the average FSC benefit declines from 1.08 percent of sales to 0.80 percent.

There is, however, another change in international taxation which is an indirect consequence of the reduction of statutory corporate rates and more than offsets the reduction in FSC benefits. Under the rules for determining the source of income (i.e., whether domestic or foreign), which were in large part not changed by the Tax Reform Act, a U.S. producer exporting abroad can arrange to classify 50.0 percent of the total taxable income from the export as foreign source.[6] Thus, if the exporter is in an excess foreign tax credit position, 50.0 percent of the export income can be effectively exempt from U.S. tax.

The foreign tax credit limitation, the amount of foreign taxes that be credited against U.S. tax liability, is basically the U.S. statutory rate applied to foreign source taxable income. In other words, it is limited to what the U.S. tax would be on the income. Therefore the reduction of the U.S. statutory corporate rate from 46 percent to 34 percent will greatly increase the number of U.S. companies in an excess foreign tax credit position. For example, Treasury data indicate that the percent of U.S. manufacturing companies (weighted by worldwide income) that are in an excess foreign tax credit position increases from 20.2 to 69.2 percent. Therefore, the 50 percent rule becomes much more important at the lower corporate rate.

The question is whether all or most of U.S. exporters who are in an excess credit position will choose not to use a FSC because they can get a higher level of tax exemption on export income simply by using the source rules. (An exporter who uses a FSC can also get some benefit from the source rules, but on only half of the export income so that the sum of the benefits [15 plus 25 percent] is less than the pure 50.0 percent exemption). In this paper, we assume that all exporters in an excess credit position will avail themselves of the maximum benefit under the source rules. We also assume that the percent of exporters in an excess foreign tax credit position is the above mentioned 69.2 percent. (In other words, we assume that weighting by exports and weighting by worldwide income yield the same results.)

When these two effects, the reduced FSC benefit and the enhanced value of the source rules, are added together, we conclude that export costs will fall by 0.50 percent, holding the cost of the equivalent domestically consumed good constant.[7] In the model, there is a equivalent reduction in the cost of capital in the export sector because both the FSC and the source rule benefits are based on taxable corporate income from exports.

D. Other Significant Changes in Domestic Taxation

The changes in domestic taxation included in the basic model runs are those described above: the change in statutory tax rates, the elimination of the general business credit, the revision of depreciation and the elimination of the capital gains exclusion. The reason for excluding the other major provisions is simply that they have not yet been put into a cost of capital framework. (See, however, the paper by Lowell Dworin on the Alternative Minimum Tax in this volume.)

However it would be of interest to know if including items such as the passive loss rule, the corporate alternative minimum tax and the uniform capitalization rules would significantly change the results. The Conference Report indicates that these three items by themselves account for $92.0 billion in increased revenue in fiscal years 1987 through 1991. An attempt was therefore made to test the sensitivity of the results by using the revenue estimates for the passive loss rule, the corporate minimum tax, and the uniform capitalization rules. Most of these major domestic items relate to the deferral of taxable income. As a consequence, the long-run fully phased-in revenue gains or losses may not sufficiently reflect the significant acceleration of income recognition (or reduced deferral) that takes place. In order to correct this possible error, two alternative simulations were made. One is based on the fully phased in estimates and the other uses the average increase in revenue estimated for the initial 5 year 1987-1991 period (i.e., the revenue estimates considered during the legislative process). This presumably overstates the actual increase in marginal effective tax rates.

We assume that the passive loss rules increase taxes only in the non-traded sector on the grounds that they mainly affect real estate partnerships. It is further assumed that the corporate minimum tax and the uniform capitalization rules increase business level taxes uniformly in all sectors because it is difficult to make judgments with respect to their sectoral impact. In each case the revenue increases are translated into percentage point changes in tax rate by expressing them as a percent of total capital income in the appropriate sector.

V. PARAMETERIZATION OF THE MODEL

The model described above contains a relatively small number of sectors and is solved in differential form, so that strictly analytical solutions could be derived from it. However, the purpose of this paper is to evaluate the quantitative significance of certain effects rather than simply their direction. Therefore, it is necessary to choose specific parameters for simulation analysis. This section provides a summary of the data and parameter values used in addition to the measures of tax changes discussed earlier.

The four aggregate goods produced in each country were created from the 85 sector input-output table of the United States. As indicated above, nontraded goods and services, x_{NA}, include utilities, construction, transportation and communication, wholesale and retail trade, social and personal services, finance, real estate, and government. U.S. net non-machinery export goods, x_{2A}, essentially are grains, and chemicals. U.S. net import goods, x_{1A}, include many consumer durables and nondurables. The output of the U.S. machinery sector is x_{MA}.

Allocations of factor inputs across industries are based upon the direct and indirect factors requirements necessary to produce current levels of output. The nontraded sector and the three traded goods sectors all have relatively similar capital requirements. The nontraded sector and the import competing sector are intensive in unskilled labor while the two export sectors are relatively skill intensive. The relative supply of these two types of labor depend on the real rate of return to investment and are therefore affected by changes in tax; for example a lower real rate of return encouraging more training.

Partial elasticities of substitution between capital and unskilled labor, unskilled labor and skilled labor, and capital and skilled labor are in part based on estimates reported in Hammermesh and Grant (1980). For example, they report a virtually zero degree of substitutability between capital and skilled labor, but the values applied to all industries in this study are $\sigma_{KL} = \sigma_{SL} = 1.0$ and $\sigma_{KS} = 0.5$, where S is skilled labor and L is unskilled labor.

Demand elasticities for goods and portfolio elasticities for savings are based on a utility tree framework developed by Armington (1969). Residents in a particular country are assumed to first allocate their income between current consumption and total saving in view of the weighted worldwide after-tax rate of return. The current consumption branch has 3 sub-branches, net export goods, net import goods and the nontraded good. Thus U.S. consumers first allocate current consumption among the net export good, the net import good and the nontraded good and then within each of the first two categories allocate income between the domestic and foreign produced good. This formulation allows us to use a high elasticity of substitution within the inner nest of the utility function (between foreign and domestic output of the same good). If this nested utility function is CES in form, then as shown by Armington (1969) own and cross-price elasticities of demand can be derived directly from information regarding expenditure shares and elasticities of substitution at different levels of the utility tree.

For a given allocation of income to current consumption the elasticity of substitution between the two traded goods in the same utility tree is assumed to be 3, and the corresponding elasticity between the three general categories X_1,X_2 and X_N is assumed to be .75. A similar nested scheme is assumed to generate the demand for each of the capital goods used in production, with X_{MA} and X_{MB} in one branch and the nontraded good in the other. As examples of what these values imply with respect to more commonly estimated parameters, the import elasticity of demand in the U.S. for X_{1B} equals -2.21, and the elasticities of demand for U.S. exports of X_{2A} and X_{MA} to the rest of the world are -2.63 and -2.64 respectively.

The elasticities of demand for assets located at home and abroad are computed in a manner analogous to the commodity demand elasticities. Making the Armington separability assumption for foreign and domestic assets within the overall savings branch yields two basic parameters, the elasticity of substitution between foreign and domestic assets, σ, and the elasticity of overall saving with respect to the weighted worldwide after-tax rate of return, η. Because values for σ are not well established, a range of estimates is used: 0.0, 3.0, and 30.0. The 3 values of σ represent zero, moderate or very high substitutability between U.S. and foreign assets. With respect to the overall saving elasticity, in this application we assume a zero interest elasticity of savings although a range has also been used in other simulations. The zero overall savings elasticity is used here to simplify the analysis and focus on the role of capital mobility.[8]

We can illustrate how these values are related to asset demand elasticities. For the case of $\sigma = 3.0$ and $\eta = 0.0$, both the own-interest rate elasticity of demand by U.S. savers for U.S. assets and the cross-interest rate elasticity with respect to foreign interest rates are equal in absolute value to .67. The corresponding own and cross-interest rate elasticities of demand for U.S. assets by foreign savers are 2.87 in absolute value. These two figures yield a weighted average interest rate elasticity of demand for U.S. assets of 1.16. Model simulations in earlier work by the authors suggest how much capital actually ends up moving if these parameters are used (Mutti and Grubert 1985). For example, a 1.0 percent increase of after-tax capital income (or a one percent reduction of the cost of capital) as a result of a corporate tax cut would result in an increase of the U.S. capital stock of .18 percent in the final general equilibrium solution. Consequently, the direct increase in demand of 1.16 percent is substantially offset in the model by induced changes in returns at home and abroad.

VI. SIMULATIONS

In order to highlight the role of certain tax changes and behavioral parameters, as well as the time frame being considered, several different scenarios are simulated. All but the last case exclude consideration of the passive loss rule, the corporate alternative minimum tax and the uniform capitalization rules.

Case 1. The short run, impact effect with moderate ($\sigma = 3.0$) capital mobility. In the short run, a savings outflow from the United States induced by a tax change can affect the demand for sectoral output and the trade balance by increasing the demand for capital goods output abroad and reducing it at home. However, the change in savings flows is not yet reflected in the capital stocks used in each country. This case is simulated by setting the two $\hat{K}$s, the percentage change in each country's capital stock, equal to zero.

Case 2. Long run, but with no interest sensitivity of international savings flows on the margin ($\sigma = 0$). This identifies the changes in trade flows and sectoral output in the absence of a change in the capital account. There can, however, be an impact on merchandise trade due to changes in after-tax returns to capital which affect net international investment income. There is initial cross-ownership of capital reflecting the actual existing situation; but the stock does not respond to changes in rates of return.

Case 3. Long run, with moderate asset mobility, ($\sigma = 3.0$)

Case 4. Long run, with very high asset mobility, ($\sigma = 30.0$)

Case 5. Moderate asset mobility ($\sigma = 3.0$) with changes in the passive loss rule, corporate minimum tax and uniform capitalization rules included in the tax changes modeled.

Table 8.3 gives the simulation results for Case 1, the immediate short run impact of the Tax Reform Act before capital stocks have had a chance to adjust (although the impact of asset mobility on sectoral demands is included). The increased corporate tax on domestic capital lowers the after tax return and leads to a reduced saving outflow of $11.4 billion (at an annual rate). Offsetting the outflow of savings somewhat is smaller net payments of investment income to foreigners because of lower after-tax returns earned in the United States. An improvement of the trade balance of $8.5 billion (rather than $11.4 billion) is thus necessary to finance the capital outflow indicated above.

The short run improvement of the trade balance takes the form mainly of increased exports, not reduced imports. One reason for this split is the relatively large increase in the tax rate on capital in the import-competing sector presented in Table 8.1. In addition there is the impact of the increased incentive for exports resulting from the increased frequency of excess foreign tax credits.

The change in the pattern of sectoral output only weakly reflects the change in exports and imports. The import-competing sector declines in the United States in spite of the decrease in imports, which thus indicates that there is a shift away from these kinds of goods in general. (Imports of these goods become somewhat more expensive because the U.S. demand for foreign assets worsens the U.S. terms of trade.) In addition, equipment output declines in spite of the increase in exports. This is due to the offsetting reduction in the demand for equipment because of lower investment spending in the United States when $11.4 billion of savings flow out. An increase in savings outflows reduces equipment production in the United States because physical capital located in a country tends to have a much larger component of domestically produced equipment than imported equipment.

The tables report the estimated change in real consumption, but it should be noted that this model focuses on the taxation of capital in the broad

Table 8.3 **Short Run Impact of Tax Reform ($\sigma=3.0$)**

Variable		Change
(^'s refer to change in percent and Δ's to change in billions of dollars at 1986 levels)		
$\hat{X}_{1A}$	Output of import-competing sector	- .59
$\hat{X}_{2A}$	Output of non-equipment export sector	1.83
$\hat{X}_{MA}$	Output of equipment sector	- .07
$\hat{X}_{NA}$	Output of nontraded sector	- .39
$\hat{i}_{A}$	After tax return in U.S.	- 4.41
$\hat{i}_{B}$	After tax return in rest of world	.08
ΔS_{AB}	U.S. acquisitions of foreign assets	10.29
ΔS_{BA}	Foreign acquisitions of U.S. assets	- 1.11
ΔF	Net change in capital outflows	11.40
ΔX	U.S. exports	7.31
ΔM	U.S. imports	- 1.16
ΔB	Net change in trade balance (not including investment income)	8.47
ΔI_{R}	Receipts of investment income	.49
ΔI_{P}	Payment of investment income	- 2.45
ΔR	Net change in investment income	2.94
$\hat{C}_{A}$	Real consumption	- .193
$\hat{t}$	U.S. terms of trade	- .97
$\hat{K}_{A}$		0.0
$\hat{K}_{B}$		0.0

sectors used and therefore abstracts from some behavioral changes which could increase real consumption. For example, the impact of real wages on total labor supply is not reflected in the model.

With that proviso, we can note that in the simulations real consumption declines in the United States, even in the short run before capital stocks have adjusted. In part, this reflects the welfare loss attributable to higher export incentives, but it is also a result of the decline of the U.S. terms of trade because of the increased demand for foreign capital. (This decline in the U.S. terms of trade, the equivalent of a real devaluation, promotes an expansion of exports.) It indicates that any improvement of the trade balance is not necessarily associated with any economic benefits to the United States. On the contrary, there is an increased overall (trade plus investment) demand for foreign output.

Summers (1986) claims that an increase in U.S. corporate tax unambiguously leads to a short run improvement in the trade balance. However, his conclusion results from his assumption that initial foreign ownership of capital, and therefore foreign investment income, is zero. The simulations indicate that the short run net change in investment income, which results from the change in after-tax returns, can be substantial, at least compared to the other changes. Because of the importance of this factor, an increase in U.S. corporate tax on capital could lead to a deterioration of the trade balance in the short run, given a somewhat lower degree of capital mobility than $\sigma = 3.0$. (For example, see the $\sigma = 0$ case in Table 8.4 where there is initial cross-ownership of capital but asset flows do not respond on the margin to changes in relative returns.)

Table 8.4 **Long Run Impact of Basic Tax Changes With Varying Degrees of Capital Mobility**

		$\sigma = 0$	$\sigma = 3.0$	$\sigma = 30.$
(^'s refer to changes in percent. Δ's refer to changes in billions of dollars at 86 levels)				
$\hat{X}_{1A}$		-1.46	-1.54	-1.59
$\hat{X}_{2A}$		0.90	0.84	0.81
$\hat{X}_{MA}$		0.46	- .18	- .51
$\hat{X}_{NA}$		- .09	- .31	- .43
$\hat{i}_{A}$		-4.38	-3.01	-2.29
$\hat{i}_{B}$		0.0	-0.43	-0.67
ΔS_{AB}		0.0	5.64	35.75
ΔS_{BA}		0.0	1.38	29.16
ΔF		0.0	-4.26	-6.59
ΔX		.24	0.57	0.76
ΔM		2.63	2.00	1.68
ΔB		-2.39	-1.43	-0.92
ΔI_{R}		- .01	5.52	37.17
ΔI_{P}		-2.40	- .18	29.69
ΔR		2.39	5.70	7.48
$\hat{K}_{A}$	U.S. capital stock	0.026	-1.17	-1.79
$\hat{K}_{B}$	Capital stock in ROW	0.033	0.40	0.61
$\hat{C}_{A}$	Steady state real consumption	-0.134	-0.240	-0.295
$\hat{t}$		- .26	- .25	- .25

Table 8.4 gives the long run steady state results for each of the 3 different mobility cases, $\sigma = 0, 3.0$, and 30.0. There is a small increase of the trade deficit in all three cases. When $\sigma = 0$, this reflects the net improvement in net investment income attributable to initial foreign ownership of capital. The reason for this improvement in net investment income is the lower U.S. rate of return earned by foreigners because of the increased U.S. taxes on business; the foreign returns received by the United States hardly change. (Note the changes in i_A and i_B in Table 8.4.) When capital is mobile, the increase in the trade deficit persists, although at a smaller level, because the continuing (in each year of the steady state) increased net demand for foreign capital is not large enough to completely offset the improvement in net foreign investment income. The latter increases as capital becomes more mobile because of the increased stock of capital abroad owned by U.S. residents.

The import competing sector bears the impact of these small changes in the trade balance and its output falls by about 1.5 percent. The equipment sector gains only in the $\sigma = 0$ case; it declines in the other cases because of the lower investment spending in the United States when capital is mobile and savings flows out.

The U.S. capital stock declines by somewhat more than 1.0 percent in the moderate and high mobility cases. Note, however, that even when capital becomes highly mobile, the decline in the U.S. capital stock is not much larger than in the moderate mobility case. The reason is that the United States is not a small country in this simulation; the rate of return in the rest of the world is not constant. A shift toward U.S. asset holding abroad increases foreign capital stocks and reduces rates of return abroad. This in turn causes foreigners, whose own asset holdings are highly mobile, to shift their asset holdings to the United States. This large two-way flow of saving is clear in the $\sigma = 30$ case where gross outflows increase by \$35.75 billion and inflows by \$29.16 billion in the steady state.

Table 8.5 presents the long run steady state impact of the Tax Reform Act when estimates of the tax changes attributable to the passive loss rule, the uniform capitalization rules, and the corporate minimum tax are included. The two columns correspond to the two alternative bases for the tax change estimates, the fully phased-in estimates and the budget period estimates used in the legislative process. The main purpose of these simulations is to see how sensitive the results are to including these provisions that are left out of the standard cost of capital calculations.

The results in Table 8.5 should be compared to the $\sigma = 3.0$ results on Table 8.4. Adding these "nonstandard" provisions has a visible effect on capital flows and the U.S. capital stock. Even when the lower bound, fully phased-in estimates are used, the decline in the capital stock goes from 1.17 percent to 1.43 percent. When the more familiar budget-period estimates for the Act are used, the decline in the capital stock becomes 2.48 percent. Leaving these "nonstandard" tax provisions out of the analysis may therefore seriously understate the impact of the Tax Reform Act.

Table 8.5 **Long Run Impact of Tax Reform Including Passive Loss Rule, Uniform Capitalization Rules, and AMT ($\sigma = 3.0$)**

Variable	Changes using fully phased-in estimates	Changes using Tax Reform Act revenue estimates (1987-1991 average)
$\hat{X}_{1A}$	-1.63	-1.66
$\hat{X}_{2A}$	.76	.69
$\hat{X}_{MA}$	- .36	- .93
$\hat{X}_{NA}$	- .36	- .67
$\hat{i}_A$	-3.34	-4.73
$\hat{i}_B$	- .52	- .91
ΔS_{AB}	6.19	8.32
ΔS_{BA}	1.02	- .70
ΔF	- 5.17	-9.02
ΔX	.44	-1.12
ΔM	2.02	1.04
ΔB	-1.58	-2.16
ΔI_R	6.01	7.84
ΔI_p	-.75	-3.34
ΔR	6.76	11.18
$\hat{K}_A$	-1.43	-2.48
$\hat{K}_B$	.48	.81
$\hat{C}_A$	-.27	-.39
$\hat{t}$	-.21	-.14

While we make an effort to evaluate the significance of these "nonstandard" items, it is only fair to remember that the simulations leave out potentially significant affects of the Tax Reform Act. Because of the aggregate nature of the study, the change in real consumption does not reflect the benefits of a more efficient allocation of U.S. capital among assets within one of the broad sectoral categories. These benefits are an important feature of the paper by Fullerton, Henderson and Mackie (1987). In addition, the specific simulations reported in this paper assume that aggregate saving is insensitive to the rate of return.

Nevertheless, even in this simplified framework, the results are not the straightforward predictable outcome of the increased business level taxes in the United States. For one thing, predicting the change in capital flows requires an analysis of also how the U.S. tax on foreign income changes. Just knowing the change in taxes on domestic income is inadequate. In addition there are other important components of the model, such as changes in the terms of trade in response to capital flows, which can have a significant impact on real income. Finally, the purpose of simulations is to evaluate the quantitative significance of certain behavioral responses, not just their direction of change.

VII. SUMMARY AND CONCLUSIONS

The Tax Reform Act of 1986 has a relatively small impact on sectoral output and trade at the broad aggregate level examined in this paper. It does not have a dramatic effect on relative costs among sectors, and in the long run there is only a modest change in the trade balance.

Still, some of the changes are not insignificant and seem fairly robust under different assumptions about behavioral parameters. In the long run output in the import competing sector declines by from 1.0 to 2.0 percent because of a relatively large increase in capital costs, the (indirect) incentives provided to exports, and the outflow of capital. The U.S. equipment sector is helped, on the one hand, because it fares relatively well in terms of domestic business tax provisions, but on the other hand it suffers from reduced investment spending in the United States. On net, output declines somewhat, but less than the output of the import-competing sector. There is a decrease in the trade deficit in the short run because of the capital outflow in response to lower after-tax returns in the United States. In the long run, there is a small ($1 to 2 billion) increased trade deficit because the increased stock of U.S.-owned capital abroad generates greater investment income and finances more imports.

The changes in the U.S. capital stock appear to be more significant for U.S. welfare than the changes in sectoral output or the trade balance.[9] When the analysis is restricted to the "basic" tax changes, the U.S. capital stock is estimated to decline in the long run by 1.0 to 2.0 percent, depending on whether moderate or very high asset mobility is assumed. Assuming virtually perfect mobility does not have a large net effect because any large allocation of assets abroad by U.S. residents drives down returns in the rest of the world and induces a large reverse flow of assets by foreign savers. However, the "nonstandard" tax provisions such as the corporate minimum tax and the uniform capitalization rules may increase the decline in the capital stock to the 2.0 to 3.0 percent range.

The results demonstrate that the merchandise trade balance is not a good indicator of U.S. welfare or even a good predictor of sectoral outputs. In the short run, the capital outflow leads to a trade surplus but, since it is the result of an increased demand for foreign output (in the form of capital goods production) abroad, the U.S. terms of trade decline and real consumption goes down. Furthermore, even though the U.S. equipment industry is normally a substantial net exporter, its output declines because of reduced investment spending in the United States. and the reduction in imports does not prevent a decline in the import competing sector.

The simulations demonstrate that changes in taxation are unlikely to have a significant impact on trade and sectoral output in the absence of international capital mobility. In the pure case (not simulated here) in which capital is not mobile and there is no initial cross-ownership of assets, a change in taxation will only affect trade to the extent that sectors are not affected uniformly (in terms of percentage cost changes), or if the overall size of the economy is altered. In addition, any increase in capital taxation in one sector relative to others translates into a much smaller percentage increase in price because of the significance of other costs such as wages, depreciation and purchases from other sectors. In contrast, if capital is mobile, a relatively modest change in the tax on U.S. capital income at the business level can have a significant effect on the trade balance in the short run, and can lead to a visible long run change in the capital stock.

FOOTNOTES

[1] While Summers (1986) stresses the importance of capital flows, he identifies competitiveness only with the size of the traded goods sector.

[2] Note that U.S. residents can import goods in the net export category, e.g., foreign agricultural products. We assume that equipment is not consumed directly by households.

[3] The particular estimates used assume a real after-tax return of 5 percent, an inflation rate of 4 percent, individual arbitrage of after-tax returns and the "new view" on dividend taxation.

[4] This procedure assumes that only operating investments abroad benefit from the rate reduction. This does not seem to require adjustment because the income in the other categories initially in the base for purposes of computing the effect of the rate cut were small or zero.

[5] Total foreign income includes total U.S. corporate foreign source net income reported on corporate tax returns, investment income received by individuals and the amount of income retained abroad by U.S. owned foreign corporations. It was estimated to be $100.0 billion in 1986. Some of the components were obtained from balance of payments data published in the *Survey of Current Business.*

[6] This refers to the special title-passage provision of the sales source rules. The Tax Reform Act requires the Treasury to conduct a study of source rules for inventory property. Nothing in this discussion should be taken as an indication of the results of the Treasury study.

[7] If we were fully consistent, we would increase the tax on real investment abroad computed in the previous section to balance the increased benefit on the margin to exports. In other words, some of the benefits of a lower statutory rate on foreign income should be attributed to exports.

[8] The zero elasticity of total saving implies that, for given income, nominal saving is fixed in terms of the numeraire good. If income is unchanged, real capital accumulation can only change if the price of the capital good changes relative to other goods.

[9] As indicated earlier, this paper focuses on capital mobility and the allocation of capital among broad sectors while abstracting from other potential sources of welfare improvements.

Labor supply and total saving do not respond to real wages or rates of return in these simulations. In addition, the simulations do not reflect the more efficient allocation of capital among specific assets within a broad sector, which is an important aspect of the paper in this volume by Fullerton, Gillette, and Mackie.

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9 IMPACT OF THE CORPORATE ALTERNATIVE MINIMUM TAX: A MONTE CARLO SIMULATION STUDY

Lowell Dworin

I. INTRODUCTION

The corporate attributes that tend to increase a firm's exposure to the minimum tax have been identified by Harter (1986). Although Harter's analysis was based on the House version of the minimum tax, his observation remains valid that a firm with a low marginal profitability and a high rate of growth in depreciable assets is more likely to be on the minimum tax. Similar results were noted by Lucke, Eisenach, and Dildine (1986). Based on a multiyear simulation study of several hypothetical representative firms, they found that the chances of being subject to the AMT depends on the nature of the mix of assets held by the firm, and are greatest in the first several years after the imposition of the tax.

Because of the assumed constancy of the parameters in their model, whatever minimum tax exposure their representative firms faced was immediate, relatively short in duration, and gave rise to an AMT credit which was rapidly utilized once the firm went off the minimum tax. In most of the cases they examined the net impact of the minimum tax on corporate tax liabilities was found to be relatively modest. Their results (which reflect the Senate version of the minimum tax) indicate that although a number of factors (a high concentration of depreciable assets, a high degree of financial leverage, rapid growth, etc.) can increase a firm's exposure to the AMT, the ability to credit the excess AMT payments significantly reduces the burden of this tax. In short, their study appears to suggest that the impact of the AMT is largely a transient one, and for many firms (especially the more established ones), is relatively unimportant. However, once both positive and negative annual fluctuations in income are considered, firms may be more frequently subject to the AMT, although the duration of their exposure may be shorter.

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In addition to their neglect of stochastic economic fluctuations, neither of these prior studies considered the possible response of the firm to the imposition of the AMT. Because a firm's exposure to the AMT is rather sensitive to its investment and financing decisions, the results obtained may thus be somewhat misleading. Indeed, the entire pattern of the firm's investment and financial decisions may have to be specified before the impact of the AMT can be fully determined. The most relevant pattern to consider would be that which maximizes the value of the firm. A significant part of this study thus examines how the optimal levels of investment and leverage vary as a function of changes in tax policy under uniform (non-stochastic) and stochastic economic conditions. These results, which are of interest in their own right, will then be used to examine the adequacy of the Office of Tax Analysis' (OTA's) AMT revenue estimates.

II. THE CORPORATE ALTERNATIVE MINIMUM TAX

A. The Nature of the Tax

The Tax Reform Act of 1986 introduced a new corporate alternative minimum tax (AMT).[1] The AMT is essentially a parallel system of corporate taxation, with its own depreciation and other tax accounting methods. Because the AMT liability is calculated as if the corporation had been subject to the AMT in all post-1986 years, even a corporation that only infrequently is subject to the AMT must routinely keep track of the adjusted basis of its depreciable assets, its stock of unused net operating losses, and all other tax attributes under both systems of taxation.

If a corporation's "tentative" minimum tax (calculated after AMT net operating loss deductions and foreign tax credits) exceeds the firm's regular tax (calculated after regular net operating loss deductions and foreign tax credits), the firm is viewed as facing the AMT. In such case, the firm must pay the tentative minimum tax, reduced (but not by more than 25%) by any allowable investment tax credits. The excess of the tentative minimum tax over the regular tax (to the extent attributable to timing differences) is allowed as a tax credit (AMT credit) against future regular (but not AMT) tax liabilities.

If the regular tax exceeds the tentative minimum tax, the firm is viewed as facing the regular tax. In this case, the firm pays the regular tax, less any available general business or AMT tax credits. Such credits (with the exception of the investment tax credit) cannot reduce the tax below the tentative minimum tax; the ITC can reduce the gross tax to 75% of the tentative minimum tax.

The base of the AMT is calculated by adjusting the firm's taxable income, adding certain tax preferences, and reducing the resulting alternative minimum taxable income (AMTI) by a $40,000 exemption (which is reduced by 25% of AMTI in excess of $150,000). The various adjustments are designed to replace many of the regular tax accounting methods with AMT accounting methods. In particular, for personal assets (equipment, vehicles, etc.) acquired after 1986, AMT depreciation is calculated using a 150% declining balance method over the mid-point ADR service life, and straight line depreciation over 40 years is required for real property acquired after 1986.[2]

A "book income" tax preference, equal to one-half the excess (if any) of the firm's book income over its AMTI (calculated before consideration of the book income preference) is included for 1987-89. For post-1989 years, this book income tax preference is scheduled to be replaced with an "adjusted current earnings" tax preference. Certain other tax preferences, largely reflective of the preferences under the old "add-on" corporate minimum tax, are also included. Although the "book income" tax preference is likely to be a significant component (at least in the near term) of the disparity between AMTI and taxable income for many firms, for the purpose of this paper this preference (and all other tax preferences) are ignored.

B. Interaction With the Regular Tax

It is known that the book income reported by corporations frequently varies from one year to the next in a seemingly random manner. More precisely, percentage changes in book income of plus or minus fifty percent or more are not uncommon, and a positive gain of such magnitude by one firm in an industry can often arise in the same year that another firm in that same industry reports a comparable percentage loss. Analysis of OTA's Corporate Tax Panel indicates that similar fluctuations in taxable income also arise, although not necessarily in synchronization with the fluctuations in book income.[3]

The relationship between the corporate AMT and the regular tax suggests that the impact of the AMT might be quite sensitive to such fluctuations. Because the regular tax rate (34%) exceeds the AMT tax rate (20%), a corporation which experiences an increase in income unaccompanied by a corresponding increase in AMT adjustments or tax preferences (arising, for example, from an unanticipated increase in sales which is assumed by the firm to be temporary, and thus not accompanied by a commensurate increase in investment in depreciable assets) will tend to face the regular tax, and be able to utilize its accumulated AMT credits. Conversely, in a bad year the corporation is more likely to face the minimum tax (and thus generate additional AMT credits which may be used in future years).

This sensitivity of the AMT to changes in the firm's economic environment may create difficulties for conventional revenue estimation studies. In estimating the impact of the AMT on tax liabilities, OTA utilizes its Corporate Tax Model, which estimates the future tax liabilities of nearly 90 thousand corporations from their tax return data from a single prior base year.[4] In this estimation process, adjustments are made for an anticipated behavioral response by the firms to the changes in tax laws, and for expected economic growth between the base year and future years. However, these adjustments generally take the form of overall scaling factors, which cannot capture the impact of fluctuations in the income of individual firms.

The AMT may also create difficulties for effective tax rate studies, in which attention is focused on marginal investment. Because of the AMT, it is more likely that each year's investment and financing decisions will affect the taxation of the income generated by past and future year's investments.[5] For example, it may affect the statutory tax rate applicable to the depreciation deductions associated with prior investments. Therefore, it may no longer be appropriate to consider the incentive to invest using a constant statutory rate, as is typically assumed in measures of marginal effective tax rates. Moreover, because of the uncertain nature of a firm's future exposure to the AMT, the investment and financing behavior of firms cannot be adequately captured by a purely deterministic analysis.

C. Objectives of This Paper

This paper reports the results of several numerical experiments designed to provide some insight on the impact of the AMT, especially under fluctuating economic conditions. These experiments were performed on a corporate Monte Carlo simulation model which was developed for this purpose. In particular, they were designed to answer the following questions:

- How would the imposition of the AMT (on top of all other 1986 Tax Reform Act changes) affect a firm's investment and financing decisions?
- Does the avoidance of the minimum tax represent optimal tax planning?
- Would the AMT significantly increase average effective tax rates?
- Do extrapolations which exclude stochastic fluctuations in the earnings of individual firms significantly impair OTA's AMT revenue estimates?

While the answers are far from definitive, they present a picture of the AMT that may be somewhat at variance with conventional wisdom. The details of this picture may change as more extensive modeling of the AMT is performed, but it is not likely that fundamentally different answers will be obtained. In the next section of this paper, the corporate Monte Carlo simulation model is described. The results of this model for a non-stochastic and stochastic economy are compared in section four, where the response of the firm to the AMT is ignored. In section five the behavioral response of the firm to the AMT is examined, and its tax implications are discussed. Section six examines the importance of utilizing stochastic modeling in estimating AMT revenues over the initial five-year budget period. Finally, based on the results of the study, some answers to the above questions are provided in the last section.

III. THE MONTE CARLO SIMULATION MODEL

In order to study the impact of the AMT on the "typical" firm, a model is required of such firm which is capable of providing realistic investment and financial decision rules under a wide variety of conditions. Although the specific decision rules incorporated in the model used in this study are consistent with those noted in Hayashi's (1982, 1985) papers on the Q theory of investment, the results of the model must be viewed as merely suggestive of the more complex interactions between the financial and investment decisions of actual firms. Nevertheless, the model appears to be a useful addition to OTA's toolkit. In particular, by allowing the interaction between changes in corporate tax policy and the investment and financial decisions of hypothetical firms to be studied in a dynamic context, the model can provide helpful insights. These insights may be used to enhance the quality of the results obtained from multi-period application of OTA's empirically based, but essentially static, Corporate Tax Model.

The Monte Carlo Simulation Model is based on the following assumptions:

- The firm owns an existing stock of homogeneous real assets (and, depending upon the parameters chosen, may also be viewed as holding a corresponding stock of homogeneous financial assets). In one version of the model all of the firm's real assets are depreciable assets; in a second version, only 75% are depreciable.
- The depreciable assets have a 12 year mid-point ADR life, a 7 year modified ACRS property class, and a 10% per year rate of economic depreciation.
- The nominal pre-tax rate of return (net of depreciation) generated by the depreciable assets is taken to be a discrete random variable, R. Unless otherwise noted, the value of this variable for any firm in any period is assumed to be equally likely to be 7% (R-) or 13% (R+), and to be independent of its prior values and also independent of its value for other firms.
- The nominal pre-tax rate of return generated by the financial assets is fixed at 9%.
- The firm may also borrow funds at 9% (unless its debt to equity ratio exceeds 30%; see below). Thus, if the firm both owns a stock of financial assets and borrows funds, only the net amount of outstanding financial assets is relevant.
- If the firm's managers wish to change the annual rate of growth of the firm's real assets, G, from its assumed "natural" value of 4%, they will incur an investment adjustment cost. This cost is assumed to be proportional to the beginning of the period stock of real assets, with a proportionality factor equal to 12.5 times the square of the difference between the chosen growth rate and 4%.[6]
- The firm's managers may make an initial choice of two possible values of G (G+ and G-). Once these two values are specified, the growth rate in each future year will be either G+ or G-, depending upon whether the firm is experiencing a "good" or "bad" year. Thus, a growth rate G+ is used if the 13% rate of return has been realized, and a growth rate G- is used if the 7% rate has been realized. The initially specified

values of G+ and G- are assumed to have been chosen so as to maximize the expected value of the firm, as noted below. It is also assumed that the growth rate of the firm's real assets was 5% in all past (pre-1987) years.

- Once the firm's investment in real assets is specified, the firm's managers must address the problem of financing such investment. They utilize the following rules:
  - A "targeted" portion of the next period's stock of real assets is financed by debt (or equivalently, the stock of real assets is mixed with a targeted portion of financial assets). The balance of the investment is financed by retained earnings. As in the case of the growth rate, the firm's managers are assumed to make an initial choice of two target debt to equity ratios (B+ and B-). Each future year's target ratio of debt to equity (or financial assets to total assets) is either B+ or B-, depending upon the realized rate of return. Thus, the target ratio of B+ is used if R+ is realized, while the target ratio B- is used if R- is realized. The initial decision parameters for the firm are thus the values of G+, G-, B+, and B-.[7]
  - After the required level of retained earnings is determined, any excess cash generated during the period is remitted to the firm's shareholders as dividends. However, if there are insufficient earnings to finance the investment, the level of the debt to equity ratio is allowed to increase beyond the target values (B+ or B-), provided it remains less than a critical value, B_c, taken to be 50%.
  - If the after-tax cash flow is insufficient to keep the debt to equity ratio below 50%, the firm is assumed to acquire new equity until this critical ratio is reached. Share repurchases are ignored.[8]
- The firm faces greater interest costs if the achieved ratio of debt to equity exceeds the firm's "natural" ratio of 30%.[9] These costs are also assumed to be proportional to the beginning of the period stock of real assets, with a proportionality factor given by .25 times the square of the excess (if any) of the prior period debt to equity ratio over 30%.[10]
- The pre-1987 debt to equity ratio is taken to be 30%, so that with a $1,000 assumed initial stock of real assets. the initial equity is $769.20.
- The firm's managers seek to maximize the expected after-tax net present value of the claims of the firm's shareholders. In particular, they maximize the sum of the expected net present after-tax value of the dividend stream over a fifty year horizon and the discounted value of the firm's net equity at the end of that period. A derivation of this objective function is presented in the Appendix.

° In evaluating these discounted present values, the discount rate used by the marginal investor is assumed to be 8%.

Some general comments on the limitations of this model of the firm may be in order. First, like most models, it is rather mechanical, and thus tends to exaggerate certain behavioral features. For example, for reasons that are not well understood, firms sometimes raise equity capital while paying dividends; such behavior is not possible in this model. Second, it treats dividends as a "residual", and thus dividend payouts fluctuate with earnings. In fact, perhaps as a signaling device, dividends are generally observed to be relatively stable over time, whereas the levels of external financing are more uneven than suggested by the model. Third, the pre-tax rates of return and the investor's discount rate are assumed invariant to a change in tax policy. This assumption may be reasonable in the short term, but is not likely to be valid over the much longer period (50 years) that is used in much of the analysis. Finally, the model restricts the choice of decision parameters to only the four initially chosen values G+, G-, B+, and B-, rather than allowing different growth rates and leverage factors to be chosen each period. The model likewise restricts the economic conditions facing the firm to be those characterized as being equally likely to result in a 13% or a 7% pre-tax rate of return (or, in the non-stochastic case, in a uniform 10% rate of return). Because of these simplifications, the results of the model may be expected to present a somewhat understated picture of the importance of allowing for the behavioral response of firms to a change in tax policy, and a somewhat overstated picture of the impact of the changes in tax policy and economic conditions on the financial success of the firm.

IV. RESULTS FOR NON-STOCHASTIC VERSUS STOCHASTIC CONDITIONS

In this section, the behavior of the firm under non-stochastic and stochastic economic conditions as compared. Specifically, it is first assumed that the the pre-tax rate of return on the firm's real assets is a constant 10% (the mean of the assumed equally likely stochastic returns of 7% and 13%). The results for this case are then contrasted with those for the stochastic case. In both cases, the behavioral response of the firm to the imposition of the AMT is ignored. Thus, the decision parameters are chosen to maximize the value of the firm's equity in the absence of the minimum tax.

A. The Case of an "Airline"

In the non-stochastic case, there are only two decision parameters which must initially be specified: the growth rate G+ = G-, and the target debt to equity ratio B+ = B-. Using an optimization routine incorporated in the model, it is found that a 5.54% growth rate and a 33.5% debt to equity ratio maximize the value of the equity of a firm with only depreciable real assets in the absence of the minimum tax.[11]

The optimal values of the decision parameters for this case (Case 1), and other cases to be described below, are noted in Table 9.1. For each case illustrated in this table, values of the financial variables resulting from the choice of the specified decision parameters are presented. A number of variables which reflect the presence of the minimum tax (and a corresponding set reflecting its absence) are shown. Thus, the value of the firm's equity (EQVALMT), the number of times during the 50 year period the firm faces the minimum tax (NMT), the discounted net present value of the tax payments incurred and the dividends remitted over the 50 year period in the presence of the minimum tax (TAXDMT and DIVDMT, respectively), the fraction of net AMT payments incurred which the firm is able to credit against the regular tax

Table 9.1 **Optimal Decision Parameters in the Absence of the Minimum Tax and the Resulting Financial Performance Under Non-Stochastic (R+ = R- = 10%) and Stochastic (R+ = 13%, R- = 7%) Economic Conditions**

	Airline		Nondurable Goods Manufacturer	
Variable	Case 1: Non-Stochastic Conditions	Case 2: Stochastic Conditions	Case 3: Non-Stochastic Conditions	Case 4: Stochastic Conditions
G+ (percent)	5.54	5.59	4.88	4.95
G- (percent)	5.54	5.48	4.88	4.89
B+ (percent)	33.5	33.8	33.5	33.5
B- (percent)	33.5	33.2	33.5	33.5
EQVALMT	$816.65	$810.72	$753.18	$752.55
NMT (years)	11.00	27.76	3.00	5.53
TAXDMT	$348.94	$352.49	$416.26	$420.15
DIVDMT	$579.96	$575.15	$580.21	$576.23
CREDUMT (percent)	100.00	87.36	100.00	100.00
REV5MT	$96.00	$ 86.72	$91.44	$94.74
EQVALNOMT	$836.62	$838.33	$753.33	$755.34
TAXDNOMT	$328.47	$330.48	$416.13	$417.78
DIVDNOMT	$599.93	$601.86	$580.36	$579.02
REV5NOMT	$65.72	$65.80	$91.42	$90.22
TINV	$38,766.44	$38,733.96	$34,937.92	$25,342.89
RATEMT (percent)	16.8	17.13	22.15	22.17
RATENOMT (percent)	15.92	15.95	22.15	22.03
MTREV5	$30.28	$20.92	$ .02	$4.52
REVDMT	$20.47	$22.01	$ .13	$2.37

over the 50 year period (CREDUMT), and the total tax revenues collected from the firm during the next five years in the presence of the minimum tax (REV5MT) are noted.

In addition to these variables, which reflect the presence of the AMT, the value of the firm's equity (EQVALNOMT), the discounted present value of the taxes paid and the dividends remitted over the 50 year period (TAXDNOMT and DIVDNOMT, respectively), and the total tax revenues collected from the firm over the next five years (REV5NOMT) in the absence of the minimum tax are noted. In addition, the total gross investment by the firm during 50 year period (TINV), which depends only upon the specified growth rates, and not the presence or absence of the minimum tax, is also shown.

Four additional variables which measure the relative impact of the AMT are also presented for each case in this table. The firm's average effective tax rate in the presence and absence of the minimum tax are noted (RATEMT and RATENOMT, respectively). These represent the ratio of the discounted present value of the tax payments during the 50 year period over the corresponding discounted present value of the economic income earned. Finally, both the increased net tax revenues due to the minimum tax during the next five years (MTREV5), and the discounted net AMT revenues over the 50 year period (REVDMT), are shown.

Thus, with the growth rate and debt to equity ratio set at the optimal levels noted, the first case in Table 9.1 shows that such firm faces the minimum tax in 11 of the 50 years examined. It thus corresponds to a representive "airline" (at a zero growth rate) in the taxonomy of Lucke et al.[12] The firm fully utilizes its AMT credits generated during the 50 year period. As shown in this table, its average effective tax rate in the absence of the the minimum tax is 15.92%, and 16.88% in the presence of the minimum tax (a 6.2% increase). Over the first five years, the additional tax revenues collected due to the minimum tax are $30.28 (a 46.1% increase). However, the discounted tax revenues due to the AMT paid over the 50 year period are $20.47 (a 6.2% increase), which is less than the five year total largely because of the utilization in the later years of the AMT credits generated in the initial years. The 6.2% increase in discounted tax payments is twice as great as the 3.1% increase obtained by Lucke et al., who, however, in addition to the differences in model parameters noted in footnote 12, also assume an 11% discount rate in contrast to the 8% discount rate used here.

In order to examine the consequences of the assumed stochastic economic conditions, the model was next run such that the rate of return each year was randomly chosen in accordance with its assumed (binary) distribution. The resulting financial results were tabulated. By replicating this procedure one thousand times, a frequency distribution of the tabulated variables was obtained. The model was designed to either output each of these values into an SPSS data file for detailed statistical analysis, or to directly output the range, mean, and variance of the calculated values.

By maximizing the mean (expected) value of the firm's equity with respect to all four initial decision parameters (G+, G-, B+, B-), it was found that different pre-determined growth rates and different targeted debt to equity ratios apply in "good" years (in which the firm realizes a 13% pre-tax rate of return on its real assets) and in "bad" years (in which the firm realizes a 7% pre-tax rate of return on its real assets). In particular, for the "airline" in the absence of the minimum tax, a 5.59% growth rate and a 33.8% debt to equity ratio in "good" years and a 5.48% growth rate and a 33.2% debt to equity ratio in "bad" years are optimal, as noted for Case 2 in Table 9.1. As may be expected, the average of these two growth rates, and the average of these two debt to equity ratios, are approximately the same as the Case 1 values.

Table 9.1 shows that the mean average effective tax rate for this case is 15.95% in the absence of the minimum tax and 17.13% in its presence (a 7.4% increase). On average, the "airline" faces the minimum tax much more frequently under stochastic conditions than under non-stochastic conditions (about 28 times as compared to 11 times over the 50 year period). The additional tax revenues due to the AMT during the first five years are $20.92 (a 31.8% increase). The AMT also leads to a $22.01 increase in the discounted present value of the taxes paid over the 50 year period (a 6.7% increase), with 87.4% of the AMT credits generated able to be utilized.

These results show that although an "airline's" frequency of exposure to the AMT is significantly increased under stochastic conditions, the five-year revenue impact of the AMT is reduced (because the firm more rapidly flips between the minimum and regular tax). However, because it cannot as fully utilize its AMT credits, the impact of the AMT on the firm's tax liabilities over the entire period examined is somewhat greater under stochastic conditions.

B. The Case of a "Nondurable Goods Manufacturer"

Also shown in Table 9.1 are the corresponding results for the second version of the model, in which the firm's depreciable assets comprise only 75% of its real assets (Cases 3 and 4). In Case 3, under non-stochastic economic conditions and in the absence of the minimum tax, the optimal growth rate is 4.88%, and the optimal debt to equity ratio is 33.5%. With these parameters, the firm faces the minimum tax in only 3 of the 50 years. It thus corresponds to a "nondurable goods manufacturer" in the taxonomy of Lucke et al.[13] Because of its ability to fully utilize the AMT credits generated, the AMT does not appreciably increase its average effective tax rate (22.15%), although it does pay $0.02 more in tax revenues in the first five years and $0.13 more in discounted tax payments over the 50 year period. A negligible increase in the discounted present value of the net AMT tax payments was also found by Lucke et al. for such firm.

The corresponding results under stochastic economic conditions for the "nondurable goods manufacturer" are presented in Case 4 of Table 9.1. In the absence of the AMT, the optimal growth rate for such firm is 4.95% in a "good" year and 4.89% in a "bad" year, while the optimal debt to equity ratio is 33.5% in both "good" and "bad" years. In this case the average frequency of exposure to the AMT is increased to 5.53 years. In contrast to the non-stochastic case, the AMT results in a significant ($4.52, or 5%) increase in tax payments over the first five years. Despite the ability of the "non-durable goods manufacturer" to fully utilize its AMT credits in both cases, under stochastic conditions the AMT results in a measurable ($2.37, or 0.6%) increase in the discounted value of the firm's tax liabilities over the entire period examined.

V. RESPONSE OF THE FIRM TO THE AMT

In the previous section, the initial decision parameters were assumed chosen so as to maximize the expected value of the firm's equity in the absence of the minimum tax. In this section, the corresponding results are presented under the assumption that these parameters are chosen so as to maximize the value of the firm's equity in the presence of the AMT. By comparing the results of this section with those of the previous section, the behavior of the firm in responding to the AMT may be studied.

A. The Behavior of an "Airline"

Turning first to the case of an "airline" under non-stochastic economic conditions, a growth rate of 5.22% and a 32.8% debt to equity ratio are found to maximize the value of the equity in the presence of the AMT. These parameters, and the resulting financial variables, are shown as Case 1 in Table 9.2 (which has the same format as that of Table 9.1).

In this case the firm faces the minimum tax in 10 of the 50 years, fully utilizes the AMT credits generated over the 50 year period, pays an additional $16.97 in taxes due to the AMT during the first five years (a 24.0% increase), and incurs a discounted present value of $13.97 in additional tax payments over the 50 year period because of the AMT. As a result, it experiences a 17.17% average effective tax rate in the absence of the minimum tax and a 17.87% average effective tax rate in its presence.

Comparing the results for Case 1 in Table 9.1 with those in Table 9.2 shows that the somewhat lower growth rate and lower debt to equity ratio chosen by the firm in response to the AMT significantly reduces the tax revenues attributable to the AMT paid by the firm during the first five years (from $30.28 to $16.97, a 44.0% decrease) and over the 50 year period (from $20.47 to $13.97 in discounted tax payments, a 31.2% reduction). However, the behavioral response does not significantly reduce the firm's exposure to the AMT (which declines from 11 years to 10 years). Moreover, despite the reduction in net AMT payments, the response of the firm does not reduce the firm's total tax payments. In fact, after responding to the presence of the

Table 9.2 **Optimal Decision Parameters in the Presence of the Minimum Tax and the Resulting Financial Performance Under Non-Stochastic (R+ = R- = 10%) and Stochastic Economic Conditions (R+ = 13%, R- = 7%)**

	Airline		Nondurable Goods Manufacturer	
Variable	Case 1: Non-Stochastic Conditions	Case 2: Stochastic Conditions	Case 3: Non-Stochastic Conditions	Case 4: Stochastic Conditions
G+ (percent)	5.22	5.24	4.87	4.90
G- (percent)	5.22	5.06	4.87	4.89
B+ (percent)	32.8	33.0	33.5	33.3
B- (percent)	32.8	32.0	33.5	33.1
EQVALMT	$820.20	$817.11	$753.19	$752.61
NMT (years)	10.00	26.49	3.00	5.53
TAXDMT	$354.86	$360.51	$416.09	$421.23
DIVDMT	$615.78	$619.12	$581.17	$578.01
CREDUMT (percent)	100.00	91.20	100.00	100.00
REV5MT	$87.76	$88.92	$91.52	$95.15
EQVALNOMT	$834.17	$834.76	$753.32	$755.33
TAXDNOMT	$340.89	$344.55	$415.96	$419.00
DIVDNOMT	$629.75	$636.64	$581.17	$580.73
REV5NOMT	$70.79	$71.07	$91.50	$90.75
TINV	$34,208.63	$33,294.32	$24,838.00	$25,088.67
RATEMT (percent)	17.87	18.29	22.18	22.26
RATENOMT (percent)	17.17	17.42	22.17	22.12
MTREV5	$16.97	$17.85	$.02	$4.40
REVDMT	$13.97	$15.96	$.13	$2.23

minimum tax, the discounted present value of the taxes paid in the presence of the minimum tax over the 50 year period ($354.86, from Case 1 of Table 9.2) exceeds the discounted value of the taxes that would have been paid in the presence of the minimum tax when the decision parameters are chosen in the absence of the AMT ($348.94, from Case 1 of Table 9.1) by 1.7%. While this result is inconsistent with tax minimization, it is not inconsistent, as noted below, with maximization of the value of the firm.

Thus, the optimal response of an "airline" to the AMT under non-stochastic conditions is not to completely avoid the AMT, but rather to reduce both its exposure to the AMT and its net AMT payments. In doing so, the firm reduces its total investment over the 50 year period by 11.8%. Because of the reduced investment, the firm's total tax payments are slightly higher, but these higher tax payments are more than offset by the higher dividend payments (the discounted present value of which increase by 6.2%). Although the resulting 0.4% increase in the value of the firm's equity (from $816.65 in Case 1 in

Table 9.1 to $820.20 in Table 9.2) is not large, it does confirm the value to the firm of the reduced level of investment in the presence of the minimum tax, despite the slight increase in total taxes.[14]

In order to determine the impact of the AMT on an "airline" when the behavioral response of the firm is allowed for, the tax variables in the presence of the minimum tax for Case 1 in Table 9.2 must be compared to the corresponding variables in the absence of the minimum for Case 1 in Table 9.1. For example, the 15.92% average effective tax rate in the absence of the minimum tax (Table 9.1) should be compared with the 17.87% average effective tax rate in the presence of the AMT (Table 9.2). In contrast to the 6.2% increase noted in the previous section when the response of the firm is ignored, when the response of the firm is considered the AMT results in a 12.3% increase in the average effective tax rate for an "airline" under non-stochastic economic conditions.

Likewise, comparing the present value of the taxes paid in the absence of the minimum tax ($328.47, from Case 1 in Table 9.1) with the present value of the taxes paid in its presence ($354.86, from Case 1 in Table 9.2), shows that the AMT leads to an 8.0% increase in total tax payments when the response of the "airline" to the AMT is allowed for. In a similar fashion, it may be seen that when the response of the firm is considered, the AMT is found to result in a 33.5% increase in taxes paid during the first five years (in contrast to the 46.1% increase noted in the previous section when the response of the firm is ignored).

As under non-stochastic economic conditions, in responding to the AMT under stochastic conditions the firm reduces its level of investment and its financial leverage. Thus, as noted in Case 2 of Table 9.2, a 5.24% growth rate and a 33.0% debt to equity ratio in "good" years are found to be optimal for an "airline" under stochastic conditions in the presence of the minimum tax, and a 5.06% growth rate and a 32.0% debt to equity ratio in "bad" years. With these parameters, the average effective tax rate in the absence of the minimum tax is 17.42%, and 18.29% in its presence. In this case the mean frequency of exposure of an "airline" to the minimum tax is approximately 26.5 times in the 50 year period. The mean of the additional tax revenues due to AMT over the first five years is $17.85, and the mean discounted present value of the taxes paid over the 50 year period due to the AMT is $15.96, reflecting the fact that on average 91.2% of the AMT credits generated are utilized during the 50 year period.

Comparison of the results for these variables in the absence of the minimum tax (from Case 2 in Table 9.1) with their corresponding values in the presence of the minimum tax (from Case 2 in Table 9.2) shows that when the response of the "airline" under stochastic conditions is considered, the AMT increases the mean average effective tax rate by 14.7% (in contrast to the 7.4% increase noted in the previous section when the response of the firm is ignored). Likewise, the AMT is found to increase the initial five year tax payments by 35.1%, and the mean discounted present value of the taxes paid by 9.1%. In responding to the AMT, total gross investment is reduced by 14.0%, and the discounted present value of the dividends paid is increased by 2.9%. As was the case under non-stochastic economic conditions, the response of the firm may be seen to significantly reduce the net AMT payments (by 14.7% over the first five years, and by 27.5% over 50 years).

Despite the reduction in net AMT payments, the discounted present value of the total taxes paid over the 50 year period in the presence of the minimum tax is actually increased ($360.51 for Case 2 in Table 2 vs. $352.49 for Case 2 in Table 9.1). However, comparison of the value of the firm's equity in these two cases ($817.11 vs. $810.72) indicates that despite the somewhat greater total taxes paid, the reduced level of investment in response to the AMT increases the value of the firm. Moreover, the mean exposure to the minimum tax when the firm responds to the AMT is about the same as when it does not (26.5 years vs. 27.8 years, respectively).

In other words, as in the non-stochastic case, the optimal response of an "airline" to the minimum tax under stochastic economic conditions does not call for avoidance of the minimum tax. Rather, by reducing its growth rate and debt to equity ratio (especially in "bad" years), a significant reduction in the level of net AMT payments may be achieved, despite the modest reduction in the firm's frequency of exposure to the minimum tax.

B. The Behavior of a "Nondurable Goods Manufacturer"

In the presence of the minimum tax, the optimal growth rate for the "non-durable goods manufacturer" under non-stochastic economic conditions is 4.87%, and the optimal debt to equity ratio 33.5%, as noted in Case 3 in Table 9.2. For these parameter values, the average effective tax rate is found to be 22.18% in the presence of the minimum tax, and 22.17% in its absence.

Comparison of Cases 3 in Tables 9.1 and 9.2 shows that the response of the firm to the AMT results in 0.4% less gross investment, a 0.1% increase in the discounted value of the dividends paid, and a negligible decrease in both the net five-year AMT payments and the discounted present value of the net AMT taxes paid over the 50 year period. Comparison of the average effective tax rate and the taxes paid in the absence of the minimum tax from Case 3 in Table 9.1 with the corresponding variables in the presence of the minimum tax from Case 3 in Table 9.2 shows that, after taking the behavioral response into account, the AMT increases the average effective tax rate and the five year tax payments of a "non-durable goods manufacturer" by 0.1%.

Since the "nondurable goods manufacturer" is barely affected by the AMT under non-stochastic economic conditions, it is not surprising that taking the response of the firm to the AMT into account does not change this result. Because the AMT was found in the previous section to have a greater impact on such firm under stochastic economic conditions, the response of the "non-durable goods manufacturer" to the AMT might also be expected to be of greater importance under stochastic conditions. The results for the "nondurable goods manufacturer" when the decision parameters are chosen to reflect the minimum tax under stochastic economic conditions are presented in Case 4 in Table 9.2. In the presence of the minimum tax. the optimal growth rates are 4.90% for a "good" year and 4.89% for a "bad" year. with a 33.3% debt to equity ratio in a "good" year and a 33.1% debt to equity ratio in a "bad" year.

Comparing the results for Case 4 in Tables 9.1 and 9.2 shows that the use of slightly lower growth rates and leverage allows the "nondurable goods manufacturer" to reduce the additional taxes paid over the initial five years due to the AMT by 2.7% (from $4.52 to $4.40). and to reduce the present value of the additional taxes paid over 50 years by 5.9% (from $2.37 to $2.23). However, the firm's frequency of exposure to the AMT remains unchanged. Allowing for the firm's behavioral response, its mean average effective tax rate is increased due to the AMT by 1.0%, its initial five year tax payments are increased by 5.5%, and the discounted present value of the taxes paid by the firm over 50 years is increased by 0.8%. In responding to the AMT, the firm reduces its investment by 1.0%. and the net present value of its dividend payments is decreased by 0.2%.

Thus, as in the case of an "airline", the behavioral response of the "nondurable goods manufacturer" to the AMT is to reduce its growth rate and financial leverage. In so doing, its net AMT payments are reduced, but its frequency of exposure to the AMT is not altered. When such response is allowed for, a greater impact of the AMT is noted (e.g., a 1.0% vs. a 0.6% increase in average effective tax rate under stochastic conditions), although even this measure indicates that the "nondurable goods manufacturer" is only slightly affected by the AMT.

VI. CONVENTIONAL AND STOCHASTIC AMT REVENUE ESTIMATES.

In this section the importance of stochastic modeling in estimating the revenues collected from the AMT is addressed. However, to simplify the analysis, the behavioral response of the firm is partially ignored. In particular, the AMT revenues will be obtained from the difference between the taxes paid by a firm during the first five years in the presence and absence of the minimum tax, holding the decision parameters equal to those found optimal under stochastic economic conditions in the presence of the AMT.

The following (somewhat simplistic) paradigm of the conventional revenue estimation process is adopted: a set of tax data for a single year (the base year) is obtained. and the income and expense items for each firm in the set are assumed to be extrapolated to each of the following five years in a uniform manner. Specifically. the growth rate and financial leverage observed for each firm in the base year is assumed to apply in all future years. The effects of a change in tax policy are imputed by superposing the new tax law on top of the uniformly extrapolated pre-tax earnings for each firm.

This paradigm, together with the assumption of uniform firm size, implies that the average five year net AMT liability as obtained from the conventional revenue estimation process corresponds to the weighted average of the five-year net AMT liabilities for firms with different (but constant) pre-tax rates of return, with a weight based on the relative distribution of such rates of return among the firms in the base year data set. The "actual" average five-year net AMT liability under stochastic conditions corresponds, however, to the mean of the stochastic five-year net AMT liability as obtained from Monte Carlo simulations.

A. Extrapolation of the Financial Results for an "Airline".

Although only the five-year budget period is relevant for the revenue estimates, the financial results for the first 12 years as extrapolated for an "airline" are examined in this section in order to illustrate certain features of the AMT. Thus, the first portion of Table 9.3 presents the results for an "airline" which always realizes a 13% rate of return on its real assets (i.e., always has a "good" year), and the second portion presents the corresponding results for an "airline" which always realizes a 7% rate of return (i.e., always has a "bad" year). As noted, the initial decision parameters are taken to be those which maximize the value of the firm's shares under stochastic economic conditions in the presence of the minimum tax (see Case 2 in Table 9.2).

A number of features exhibited in Table 9.3 are worth noting. First, the firm which realizes a constant 13% return (which shall be referred to hereafter as a "13%" firm) is able to maintain its target 33% debt to equity ratio, and thus, by the logic of the model, pays a dividend each year. Second, in the presence of the minimum tax, the 13% firm faces the AMT in three of the 12 years (years 2, 3 and 7), and is able to utilize the AMT credit generated in the following years. Third, by dividing each year's tax paid by the economic income earned, an annual average effective tax rate may be defined. The maximum tax rate experienced by a "13%" firm (28.35% in year 5) is less than the statutory regular tax rate (34%).

In the case of an "airline" which realizes a 7% rate of return (referred to hereafter as a "7%" firm), the results are different. First, the "7%" firm cannot maintain its targeted 32% debt to equity ratio (which grows to 37.5% by the tenth year). Thus the "7%" firm ceases to pay dividends after the second year. Second, the "7%" firm faces the minimum tax in each of the twelve years. Third, the annual average tax rate, obtained by dividing the tax paid by the economic income earned, increases beyond the 20% statutory minimum tax rate in the third through ninth years. This is due to the fact that the lower depreciation on the firm's pre-1987 assets is not allowed to offset the depreciation adjustments for its post-1986 assets.

This aspect of the AMT was noted by Christian, Schutzer, and Nilles (1986). The magnitude of this effect decreases with higher pre-tax rates of return.

Table 9.3 **Financial Results for an "Airline" Earning a Constant Pre-tax Return: The 7% and 13% Cases**

	Year 1	2	3	4	5	6	7	8	9	10	11	12
At 13%:												
With Minimum Tax		*	*				*					
Debt Equity Ratio	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%
Cash Generated	$207.31	$216.29	$227.63	$239.55	$252.11	$265.32	$279.22	$293.85	$309.25	$325.45	$342.51	$360.45
New Debt	$30.35	$13.68	$14.40	$15.16	$15.95	$16.78	$17.66	$18.59	$19.57	$20.59	$21.66	$22.81
Gross Investment	$152.40	$160.39	$168.79	$177.63	$186.94	$196.74	$207.05	$217.90	$229.31	$241.33	$253.98	$267.28
Tax Paid	$19.14	$19.34	$23.48	$28.31	$36.69	$34.11	$32.75	$32.23	$34.25	$36.60	$38.52	$40.54
Dividends	$66.12	$50.24	$49.76	$48.77	$44.42	$51.25	$57.08	$62.31	$65.25	$68.11	$71.68	$75.43
Economic Income	$107.31	$111.05	$116.87	$122.99	$129.44	$136.22	$143.36	$150.87	$158.78	$167.10	$175.85	$185.07
Average Tax Rate	17.84%	7.42%	20.09%	23.02%	28.35%	25.04%	22.84%	21.36%	21.57%	21.90%	21.91%	21.91%
AMT Credits		$.13	$.68				$1.35	$.53				
Without Minimum Tax												
Debt Equity Ratio	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%	33.00%
Cash Generated	$207.31	$216.29	$227.63	$239.55	$252.11	$265.32	$279.22	$293.85	$309.25	$325.45	$342.51	$360.45
New Debt	$30.35	$13.68	$14.40	$15.16	$15.95	$16.78	$17.66	$18.59	$19.57	$20.59	$21.66	$22.81
Gross Investment	$152.40	$160.39	$168.79	$177.63	$186.94	$196.74	$207.05	$217.90	$229.31	$241.33	$253.98	$267.28
Tax Paid	$19.14	$19.21	$22.93	$28.98	$36.69	$34.11	$31.40	$33.05	$34.78	$36.60	$38.52	$40.54
Dividends	$66.12	$50.37	$50.30	$48.09	$44.42	$51.25	$58.43	$61.49	$64.72	$68.11	$71.68	$75.43
Economic Income	$107.31	$111.05	$116.87	$122.99	$129.44	$136.22	$143.36	$150.87	$158.78	$167.10	$175.85	$185.07
Average Tax Rate	17.84%	17.30%	19.62%	23.56%	28.35%	25.04%	21 90%	21.91%	21.90%	21.90%	21.91%	21.91%
At 7%:												
With Minimum Tax	*	*	*	*	*	*	*	*	*	*	*	*
Debt Equity Ratio	32.00%	32.00%	32.00%	32.19%	34.20%	35.29%	36.16%	36.83%	37.27%	37.50%	37.50%	37.27%
Cash Generated	$147.83	$154.10	$161.90	$169.95	$178.00	$185.87	$194.20	$203.07	$212.55	$222.73	$233.68	$245.51
New Debt	$23.92	$12.89	$14.81	$19.15	$24.62	$24.58	$24.47	$24.26	$23.93	$23.39	$22.61	$21.55
Gross Investment	$150.60	$158.22	$166.23	$174.64	$183.47	$192.76	$202.51	$212.76	$223.52	$234.83	$246.72	$259.20
Tax Paid	$4.31	$7.00	$10.48	$14.47	$19.15	$17.69	$16.16	$14.58	$12.95	$11.28	$9.58	$7.86
Dividends	$16.84	$1.77	$.00	$.00	$.00	$.00	$.00	$.00	$.00	$.00	$.00	$.00
Economic Income	$47.83	$49.04	$51.52	$53.99	$56.18	$57.88	$59.73	$61.80	$64.13	$66.79	$69.86	$73.39
Average Tax Rate	9.01%	14.27%	20.34%	26.80%	34.09%	30.56%	27.06%	23.59%	20.19%	16.89%	13.71%	10.71%
AMT Credits	$4.31	$11.31	$21.78	$31.72	$38.58	$48.18	$60.66	$71.69	$81.19	$89.04	$95.12	$99.30
Without Minimum Tax												
Debt Equity Ratio	32.00%	32.00%	32.00%	32.00%	32.32%	32.07%	32.00%	32.00%	32.00%	32.00%	32.00%	32.00%
Cash Generated	$147.83	$154.10	$161.90	$170.09	$178.70	$187.48	$197.17	$207.22	$217.70	$228.72	$240.29	$252.45
New Debt	$23.92	$12.89	$13.54	$14.22	$17.31	$13.91	$15.92	$17.33	$18.21	$19.13	$20.09	$21.11
Gross Investment	$150.60	$158.22	$166.23	$174.64	$183.47	$192.76	$202.51	$212.76	$223.52	$234.83	$246.72	$259.20
Tax Paid	$.00	$.00	$.00	$4.58	$12.53	$8.63	$4.70	$4.96	$5.21	$5.47	$5.75	$6.04
Dividends	$21.15	$8.77	$9.21	$5.10	$.00	$.00	$5.89	$6.83	$7.18	$7.54	$7.92	$8.32
Economic Income	$47.83	$49.04	$51.52	$54.10	$56.73	$59.10	$61.91	$64.74	$67.70	$70.88	$74.33	$78.09
Average Tax Rate	.00%	.00%	.00%	8.47%	22.09%	14.60%	7.59%	7.66%	7.70%	7.72%	7.74%	7.73%

*Years in which the firm faces the AMT are noted with asterisk.

This may be seen by comparing the average tax rate for the "13%" firm in year seven (when it faces the AMT), which is only 2.84 percentage points in excess of the 20% statutory AMT rate, with the 14.09 percentage point excess for the "7%" firm (in year five). Even this 34.09% maximum tax rate for the "7%" firm is barely above the 34% statutory rate for the regular tax, and is unlikely to reach the values suggested by Christian et al. (who implicitly assume a very low 1.5% pre-tax rate of return in much of their paper by ignoring the income, but not the depreciation, generated by the pre-1987 assets). Nevertheless, this feature reflects the fact that the base of the AMT differs from economic income.

B. Revenue Estimates for an Airline

The variables relevant to the issue of the importance of stochastic fluctuations in five year AMT revenue estimates are presented in Table 9.4. These include the five year taxes paid by the "13%" and "7%" firms with and without the AMT (and the resulting five year AMT revenue pick-up, obtained as the difference between these two amounts), the stock of unused AMT credits available at the end of the fifth year, and the AMT credit utilization rate for the five-year period. Also shown in Table 4 is the average of these results for the two fixed-return cases, together with the mean value of the stochastic variables and the percentage differences between these average and mean values. Table 9.4 shows that the five-year total tax payments for the "13%" firm are the same with and without the AMT ($126.96), since the AMT

Table 9.4 **Five-Year AMT Revenue Estimates From Conventional (Approximate) and Stochastic (Exact) Procedures, and Percentage Differences**

Tax Variable	13% Firm	7% Firm	Average (Approx.)	Mean (Exact)	Percentage Difference
Airline:					
Tax Paid with AMT	$126.96	$55.41	$91.19	$88.92	2.55%
Tax Paid without AMT	$126.96	$17.11	$72.04	$71.07	1.36%
AMT Revenue	$.00	$38.30	$19.15	$17.85	7.28%
AMT Credit Balance	$.00	$38.58	$19.29	$18.22	5.87%
AMT Credit Utilization	100.00%	.00%	50.00%	15.02%	232.89%
Nondurable Goods Manufacturer:					
Tax Paid with AMT	$147.71	$54.49	$101.10	$95.15	6.25%
Tax Paid without AMT	$147.71	$35.52	$91.62	$90.75	.95%
AMT Revenue	$.00	$18.97	$9.49	$4.40	115.57%
AMT Credit Balance	$.00	$19.06	$9.53	$7.28	30.91%
AMT Credit Utilization	100.00%	.00%	50.00%	69.89%	-28.46%

credits generated in years 2 and 3 are utilized in year 4. By contrast, the "7%" firm incurred an additional $38.30 in tax payments due to the AMT during the first five years. The average net five year AMT payment for the two fixed-return cases ($19.15) somewhat overstates the mean value as obtained from the Monte Carlo simulations ($17.85). As a result, it may be inferred that the conventionally calculated average five-year AMT revenues overstate the actual revenues (the mean of the stochastic values) by 7.3%.

At first glance, it would appear that the conventional AMT revenue estimation process may not be significantly impaired by the absence of explicit stochastic modelling.[15] However, because the mean stochastic value of the five-year AMT credit utilization rate is only 15.02%, this result may not be of general validity. The ability to utilize previously generated AMT credits adds to the potential disparity between the conventional and stochastic AMT revenue estimates. A greater difference in estimated AMT revenues might thus be observed for a firm which, on average, faces the minimum tax somewhat less frequently over the first five years than an "airline". This hypothesis is tested by examining the revenue estimates for a "nondurable goods manufacturer".

C. Revenue Estimates for a "Nondurable Goods Manufacturer"

The financial results for a "nondurable goods manufacturer", where the decision parameters are those found to be optimal under stochastic conditions in the presence of the minimum tax (Case 4 of Table 9.2) are somewhat different from those noted above for an "airline". In the case of a "nondurable goods manufacturer", the "13%" firm does not face the AMT in any of the first twelve years, while the "7%" firm faces the AMT in each of the first eleven years (but not in the twelfth year). As in the case of an "airline", the debt to equity ratio of the "7%" firm quickly exceeds the target value, and thus the firm does not pay any dividends after the third year. The maximum average tax rate for the "7%" firm is 30.75% (10.75 percentage points above the 20% AMT statutory rate).

Table 9.4 presents the total tax revenues paid by the "13%" and "7%" firm during the first five years, both with and without the minimum tax. It also shows the AMT credit balance at the end of the five year period, and the five-year AMT credit utilization rate (which is taken to be unity in the case of the "13%" firm, which does not face the AMT during this period). The mean value of the AMT credit utilization rate is 69.9%. This is a much greater utilization rate than was observed for the "airline" and thus a greater difference between the conventional and stochastic revenue estimates may be anticipated for such firm. Indeed, comparison of the average of the two fixed-return cases with the mean stochastic value as shown in the table indicates that the conventional five year AMT revenue estimate ($9.49) overstates the mean stochasic value ($4.40) by 115.6%.

These disparate results for the "airline" and the "nondurable goods manufacturer" clearly indicate that the importance of utilizing stochastic revenue estimation depends upon the nature of the firm. If firms which face the minimum tax are more like an "airline", it is likely that no significant five-year revenue estimation error would result from the conventional estimation procedure. However, if most firms resemble the "nondurable goods manufacturer", serious errors might arise, despite the lower AMT payments attributable to such firms. While the results may thus be somewhat ambiguous with respect to the importance of incorporating stochastic modelling in estimating AMT revenues over a five year period. significant errors almost certainly would result from the neglect of stochastic fluctuations when calculating the relative impact of the AMT on tax liabilities over periods much greater than five years. Thus. for example, the average of the "13%" and "7%" present values of the discounted excess AMT payments for an "airline" over the 50 year period examined is $41.32. which is approximately 158% greater than the actual (mean stochastic) value of $15.96. This is a much greater disparity than the 7.3% overstatement of the initial five-year AMT revenues noted for such firm, and is largely due to the inadequate picture of the actual AMT credit utilization provided by averaging the results of the two fixed-return cases.

VII. CONCLUSIONS

The numerical experiments described in this paper were performed to shed additional light on the impact of the corporate AMT, especially under stochastic economic conditions. While the results are somewhat ambiguous regarding the importance of stochastic modelling in estimating AMT revenues over a five year budget period. they clearly reveal the importance of allowing for both stochastic fluctuations and the behavioral response of firms when evaluating the overall impact of the AMT.

More specifically, a corporation with the characteristics of an "airline" faced the AMT in 11 of the 50 years examined under non-stochastic conditions, but is on average exposed to the AMT in nearly 28 of the 50 years examined under stochastic conditions. Likewise, a corporation with the characteristic of a "nondurable goods manufacturer" faces the AMT in only 3 out of the 50 years under non-stochastic conditions, but on average is exposed to the AMT in nearly 6 of the 50 years under stochastic conditions.

In response to the AMT, firms are likely to reduce their average growth rate and their target debt to equity ratio, although the magnitude of the response varies with their degree of exposure to the AMT. Thus the "airline" reduced its total investment over the 50 year period examined by 11.8% under non-stochastic conditions. and by 14.0% under stochastic conditions. Much smaller reductions in investment (0.4% and 1.0%, respectively) were found for the "nondurable goods manufacturer", which is only barely affected by the AMT.

Although the behavioral response reduced both the firm's exposure to the minimum tax (very slightly in the case of the "airline", but somewhat more significantly in the case of the "nondurable goods manufacturer") and the magnitude of the resulting net AMT payments, the optimal response cannot be characterized as an attempt to avoid facing the AMT. Moreover, because of the reduced level of investment in depreciable assets in response to the AMT, in some cases the firm's total tax payments increased slightly (despite the significant reduction in net AMT payments). While such result may appear perverse to those accustomed to think in terms of tax minimization, it is consistent with the maximization of the value of the firm's equity, which is taken to be the objective of the firm in this paper.

Conventional simulation studies (see, e.g., Lucke et al.) suggest that the impact of the AMT on corporate tax liabilities will be relatively modest, largely because the higher payments will rapidly be credited against future regular tax liabilities. However, such view is based on a comparison between the tax liabilities with and without the AMT under arbitrary assumptions about the firm's (assumed fixed) growth rate and financing decisions. As the results of this study indicate, a much greater impact of the AMT is found when the response of the firm to its tax environment is considered. Thus, for example, when the firm is allowed to optimize its investment and financing decisions to reflect the presence or absence of the AMT, the AMT is seen to increase the average effective tax rate of an "airline" by 12.2% under non-stochastic conditions, and by 14.7% under stochastic conditions. By contrast, had fixed investment and financial parameters been assumed, the resulting increase in the average effective tax rate would have been about one half of these values.

The importance of stochastic extrapolation in estimating AMT revenues over a five year budget period is not clearly demonstrated. In the case of an "airline", which is subject to relatively high AMT payments, the conventional five-year AMT revenue estimate overstated the actual value by only 7.3%. However, the conventional AMT revenue estimate resulted in a 115.6% overstatement for a "nondurable goods manufacturer" (although the net AMT payments for such firm are relatively modest). The magnitude of the disparity between the conventional and stochastic revenue estimates may be partially explained by the difference in the mean AMT credit utilization rates; a higher utilization rate portends a greater disparity in revenue estimates.

APPENDIX

In this Appendix, the objective function noted in Section III will be derived. A shareholder's after tax rate of return R_t is a mix of dividend income and capital gains:[16]

$$R_t = (1-m)D_t/V_t + (1-z)(V^{\circ}_{t+1}-V_t)/V_t. \qquad (9.A1)$$

where D_t denotes the dividends paid in period t, V_t is the total value of the firm in period t, V^o_{t+1} is the period t+1 value of the shares outstanding in period t, m is the investor's marginal tax rate on dividend income, and z is the investor's marginal effective tax rate on capital gains.

The total value of the firm in period t+1, V_{t+1}, is the sum of V^o_{t+1} and the value of new shares issued in period t, V^N_t. If the rate of return, R_t, may be taken to be a constant (ρ), then Equation (9.A1) may be written as:

$$V_t = (1+\rho/1\text{-}z)^{-1}[\delta D_t - V^N_t + V_{t+1}], \qquad (9.A2)$$

where $\delta = (1\text{-}m)/(1\text{-}z)$. Equation (9.A2) may be solved iteratively, under the condition that $(1+\rho/1\text{-}z)^{-j} V_{t+j} \to 0$ as $j \to \infty$. Thus,

$$V_t = \Sigma^{\infty}_{j=0} (1+\rho/1\text{-}z)^{-(j+1)}[\delta D_{t+j} - V^N_{t+j}]. \qquad (9.A3)$$

Equation (9.A3) is the well known "fundamental value equation" for the firm. The firm's managers may be expected to make investment and financial decisions which maximize V_t. In performing our Monte Carlo simulation we shall be evaluating the individual terms in the sum on the right hand side of Equation (9.A3) for each of the approximately one thousand trial runs. It would obviously be helpful to be able to terminate the sum after a reasonable (say T) number of terms. Had Equation (9.A2) merely been iterated forward to period t+T, we would find:

$$V_t = \Sigma^{T-1}_{j=o} (1+\rho/1\text{-}z)^{-(j+1)}[\delta D_{t+j} - V^N_{t+j}] + (1+\rho/1\text{-}z)^{-T} V_{t+T}. \qquad (9.A4)$$

Thus, if a reasonable approximation can be obtained for V_{t+T}, the computational efforts required can be significantly reduced. By making a few additional assumptions regarding the behavior of the firm in period t+T and later years, such an approximation may be obtained. In particular, we shall suppose that for period T and all later periods the firm earns only the (certain and constant) marginal return, that it maintains a constant debt to equity ratio Θ, and that its dividend payout grows at a constant growth rate g. Since the firm is assumed to be paying dividends in year T and all later years, it follows from our model that it does not issue any new stock in any of these years ($V^N_{t+T+j} = 0$ for all j).[17]

From Equation (9.A3) we may thus express the value of the stock in period t+T in terms of the dividend payment in that period and in all later periods:

$$V_{t+T} = \Sigma^{\infty}_{j=o} (1+i\delta)^{-(j+1)} \delta D_{t+T}(1+g)^j = \frac{\delta D_{t+T}}{(i\delta - g)}. \qquad (9.A5)$$

In our model dividends are a residual:

$$D_{t+T} = X_{t+T} - R_{t+T} - T_{t+T} - B_{t+T} - (I_{t+T} - B_{t+T+1}). \qquad (9.A6)$$

where X_{t+T} is the pre-tax operating earnings, R_{t+T} is the interest payment on the beginning of the period debt (B_{t+T}), I_{t+T} is the gross investment, and T_{t+T} is the tax liability, all for period $t+T$. Because of our model assumptions, each of these terms are proportional to K_{t+T}, the capital stock in period $t+T$.[18] Thus, we may write Equation (9.A6) for D_{t+T} as:

$$D_{t+T} = \{[r^* - i(1-\delta)(\Theta/1+\Theta)](1-t^*) - g - (i\delta - g)\Theta/1+\Theta\}K_{t+T}. \tag{9.A7}$$

where r^* is the (certain and constant) pre-tax rate of return, i is the interest rate, Θ is the debt to equity ratio, and t^* is the average effective tax rate. Substituting this expression into Equation (9.A5), we obtain:

$$V_{t+T} = \delta\left[\left(\frac{r_o - g}{i\delta - g}\right) - \frac{\Theta}{1+\Theta}\right]K_{t+T}, \tag{9.A8}$$

where the first bracketed expression on the right hand side of Equation (9.A7) has been denoted by r_o. Our assumption that the firm earns only marginal returns in period T and later years implies that this rate of return equals $i\delta$ so that Equation (9.A8) may be written:

$$V_{t+T} = \delta\left[1 - \left(\frac{\Theta}{1+\Theta}\right)\right]K_{t+T} = \delta\,(K_{t+T} - B_{t+T}) = \delta E_{t+T}, \tag{9.A9}$$

where E_{t+T} is the period $t+T$ equity value of the firm. By substituting this expression for V_{t+T} into Equation (9.A4), we finally obtain our objective function:

$$V_t = \Sigma_{j=o}^{t-1}(1+\rho/1-z)^{-(j+1)}[\delta D_{t+j} - V^N_{t+j}] + (1+\rho/1-z)^{-T}\delta E_{t+T}. \tag{9.A10}$$

FOOTNOTES

[1] The alternative minimum tax technically refers only to the excess of the tentative minimum tax over the regular tax. In this paper, such excess shall be denoted as "net AMT", while the phrase "alternative minimum tax" (or AMT) shall be used to refer in a conceptual sense to the entire minimum tax (and not merely its excess over the regular tax).

[2] Other adjustments have the effect of repealing the completed contract method of accounting for long term contracts and the installment method of accounting for the sale of goods for AMT purposes. Neither of these adjustments are relevant for the examples considered in this paper.

[3] The Corporate Tax Panel, which was developed by Paul Dobbins, contains complete multi-year tax data (covering the period 1970-82) for approximately 6,000 firms. A greater than 50% increase in tax net income is observed in 28.4% of the cases, and a corresponding increase in book net income in 25% of the cases. A greater than 50% decrease in tax net income is observed in 21.7% of the cases, and a corresponding decrease in book net income in 16.3% of the cases. A significant correlation between the annual changes in tax and book net income is evident.

[4] As described in Nester (1977), the Corporate Tax Model is essentially a tax calculator which utilizes an I.R.S. Statistics of Income corporate tax file as an initial data base. Tax law changes are programmed into the calculator. Such changes are either calculated directly from the original file values (as in the case of a change in tax rates) or exogenously determined (such as changes in depreciation deductions, which are imported from OTA's Depreciation Model; see the paper by Gerardi, Milner, Whitaker, and Wyscarver in this *Compendium*).

[5] The possibility that current investment may alter the taxation of the income generated by prior (and future) investment is already a feature of tax law. See, e.g., Hughes and McFetridge (1985) for a discussion of the implications of the incremental R&E tax credit on investment, or Auerbach (1986) for an analysis of the net operating loss provisions on investment. While the NOL provisions have been incorporated in the model used in this paper, the R&E credit has been ignored.

[6] A quadratic investment adjustment cost function has been used by Summers (1981) and by Poterba and Summers (1983) in their studies of the importance of dividend taxation, which were also based on the Hayashi model of the firm. While the specific parameters characterizing the adjustment cost function used in this paper and those in each of these earlier papers differ somewhat from each other, the resulting adjustment costs are all of the same magnitude.

[7] Although the model allows the firm's level of investment and its level of debt (or financial assets) to vary (in a pre-determined manner) in accordance with the realized profit margin, it does not allow the firm to "fine-tune" its investment plans according to whether it might or might not otherwise face the minimum tax. The model thus does not fully replicate the tax planning available to firms, and might therefore overstate the impact of the AMT.

[8] Shoven (1986) has stressed the increasing importance of share repurchases as a mechanism for distributing cash from the corporation to its shareholders. His analysis of the tax advantage of this mechanism neglects the possibility that such repurchases might be treated as dividend distributions under I.R.C. Section 302. Moreover, the tax advantage of such mechanism has been reduced by the Tax Reform Act of 1986. Nevertheless, the neglect of this alternative use of corporate funds must be recognized as a limitation of the model.

[9] Fullerton and Gordon (1983) note that the average 1973 debt to capital ratio across all industries is approximately .4, which in turn implies an average debt to equity ratio of .67. However, this value, which is based on market (rather than book) values of the firm's debt and equity securities, reflects in part the high debt ratios for financial institutions; lower ratios are observed for most of the manufacturing sectors. As used in this paper, "debt" actually refers to the excess of the firm's interest bearing financial liabilities over its interest yielding investments. The corresponding .3 "natural" debt to equity ratio used in the model is the average ratio for manufacturing firms, as obtained (after adjustment for deferred taxes and other reported non-interest bearing liabilities) from the 2nd quarter 1986 Quarterly Financial Report published by the U. S. Department of Commerce (1986).

[10] Alternative leverage cost functions have been used in other studies, e.g., Gordon and Malkiel (1980) and Fullerton and Gordon (1983), and have generally been viewed as reflecting the risk premium associated with the increasing possibility of bankruptcy with greater leverage.

[11] The investment adjustment cost function and the financial leverage cost function are responsible for "interior" solutions being obtained from the model. In their absence, both the firm's optimal growth rate and its debt to equity ratio would tend toward infinity.

[12] The "airline" in the paper by Lucke, et al. is characterized as having 15% of its property in inventories and land, 10% in real property, 10% in computer equipment (6-year ADR mid-point life), and 65% in aircraft (12 year ADR mid-point life). In the case noted in this paper, more of the firm's property (100% vs. 85%) is assumed to be depreciable, and a higher nominal growth rate (5.54% vs 4%) and lower nominal pre-tax rate of return (10% vs. 11%) are also assumed. However, the lower debt to equity ratio (33.5% vs. 42.9%) and the different asset mix assumed results in an equal frequency of exposure to the AMT under non-stochastic conditions. Whereas Lucke et al. sought to explicitly model a representative airline, it is only because of this equality that the firm modeled in this paper is referred to as an "airline".

[13] In the paper by Lucke et al., 20% of the property of the "nondurable goods manufacturer" is non-depreciable. The balance of the property consists of real property (30%), special tools with a 4-year ADR mid-point life (5%), machinery with a 10 year ADR mid-point life (20%), and machinery with a 12 year ADR mid-point life (25%). As in the case of the "airline", the lower debt to equity ratio and difference in asset mix appears to offset the differences in the other assumed parameters (as noted in footnote 12), resulting in an equal frequency of exposure to the AMT. It is only because of this equality that the firm represented in the second version of the model of this paper is referred to as a "non-durable goods manufacturer".

[14] Likewise, by comparing the value of the firm's equity in the absence of the minimum tax for the initial (Case 1 in Table 1) decision parameters ($836.62), with the corresponding value for the new decision parameters ($834.17 for Case 1 in Table 2), the advantage of the initial parameters over the altered parameters in the absence of the minimum tax may be confirmed.

[15] In order to investigate the robustness of this result for an "airline", the corresponding error under alternative stochastic conditions has been examined. In cases where the independence of the returns across firms is maintained, the average pre-tax return kept at 10%, and the decision parameters for Case 2 of Table 2 are used, this result appears somewhat sensitive to the assumed distribution of pre-tax returns. For example, a 0.7% error was observed with 12% and 9% pre-tax rates of return (the 9% return being twice as likely), and a -.6% error was observed in the case of an 11% and 8% rate of return (the 11% return being twice as likely). However, with a 12% and 6% pre-tax rate of return (with the 12% return twice as likely), a -23.0% error was observed. Moreover, if the returns for different firms are correlated, a greater error may easily arise. For example, if 13%, 11%, 9%, and 7% pre-tax rates of return are equally likely (with the 13% or 9% returns occurring in "good" years, and the 11% or 7% returns occurring in "bad" years, and with "good" or "bad" years equally likely), a -31.1% error would arise if the initial data year were a "good" year, and a 28.7% error would arise if the initial data year were a "bad" year. Such errors largely reflect the failure in this case of projecting future economic conditions on the basis of a single year's data.

[16] We are following, to the extent possible, the discussion and notation of Poterba and Summers (1985). References to the future value of the firm's outstanding shares or future dividend payments should be understood as the expected value of such variables.

[17] Under these assumptions, the investor's required return ρ for year $t+T$ and later years may be taken to be $i(1-m)$, where i is the nominal pre-tax interest rate (assuming that the marginal tax rate on interest income is the same as that on dividend income).

[18] This is not quite valid. The tax liability in period $t+T$ may well involve terms (e.g., the stock of unused AMT credits) which are not proportional to K_{t+T}.

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10 THE EFFECT OF THE TAX REFORM ACT OF 1986 ON COMMERCIAL BANKS

Thomas S. Neubig and Martin A. Sullivan

I. INTRODUCTION

Before tax reform, several studies concluded that commercial banks had low effective tax rates.[1] Thus, banks seemed likely candidates for tax reform, and subsequently they have been cited as one of the industries most adversely affected by the Tax Reform Act of 1986. Revenue estimates indicate that commercial banks will pay an additional $4 billion in taxes over the next five years. Like most estimates quoted during tax reform, this figure only includes the effects of bank-specific provisions.

This paper analyzes the overall effect of tax reform on the banking industry and shows that the banking industry benefits from tax reform. We estimate that as a result of tax reform commercial banks will pay more Federal income tax. However, their before-tax income will rise by more than the increase in taxes, with the net result of an increase in after-tax income. Pre-tax earnings rise because of portfolio shifting from tax-exempt bonds to taxable investments. This combined with the reduction in the corporate tax rate from 46 percent to 34 percent more than offsets the loss of bank-specific tax advantages.

In this paper, a banking model with individual bank data from 1977 to 1984 simulates the effects of tax reform on the banking industry. Aggregate tax revenue cannot be calculated from aggregated data. A disaggregate model of individual banks is necessary because a model using only aggregate data cannot calculate the effects of the minimum tax, tax-exempt bond holdings, and the amount of the tax bad debt reserves on individual banks.

The model extrapolates the 14,400 banks' income statements and balance sheets through 1991 and calculates Federal tax liability and after-tax income before and after tax reform. The model allows the separate estimation of the

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effects of each of the major tax reform provisions affecting banks, including recapture of existing bad debt reserves and the adjustment to new levels of tax-exempt bond holdings.

The paper has five additional sections. The second section explains the tax reform provisions most directly affecting commercial banks. The third and fourth sections describe the model and data used for the simulations. The fifth section presents the simulation results of the effects of tax reform as well as some sensitivity analysis of changes to the key parameters. The final section includes a discussion of some limitations of the simulations and some future lines of research.

II. TAX REFORM PROVISIONS AFFECTING COMMERCIAL BANKS

Commercial banks are generally subject to the same tax rules as all other corporations. For instance, the corporate rate structure, the alternative minimum tax, and the investment tax credit and depreciation rules apply to all corporations. Several bank-specific tax rules were changed in tax reform: the bad debt reserve deduction, the deduction for interest incurred to carry or purchase tax-exempt bonds, the cash method of accounting, and the net operating loss carryover rules. In addition, the book income preference of the alternative corporate minimum tax will affect many commercial banks because book income includes interest from their large holdings of tax-exempt bonds.

A. Bank Specific Provisions

In this section we look at each of these bank-specific provisions both under prior law and under the Tax Reform Act of 1986.

1. Bad Debt Reserve Deductions

a. Prior Law

Under prior law, banks could deduct loan losses using one of three methods: the specific charge-off method, the experience reserve method, and the percentage of eligible loan reserve method. The specific charge-off method permits deductions when the loans are considered either wholly or partially worthless. If part or all of the principal of such a loan is later recovered, the amount of the recovery is then included in the bank's taxable income. Under the specific charge-off method the bad debt reserve deduction at time t, $BDRD_t$, equals the charge-offs net of recoveries, NCO_t.

For growing firms, the two reserve methods are more advantageous. Under the methods, banks are allowed deductions to maintain reserves at the year-end allowable level AR_t after subtracting net charge-offs against the beginning year reserve, AR_{t-1}. Thus, for both reserve methods bad debt reserve deductions equal additions to allowable reserve plus net charge-offs, as shown in equation 10.1.

$$\begin{aligned} BDRD_t &= AR_t - (AR_{t-1} - NCO_t) \\ &= (AR_t - AR_{t-1}) + NCO_t \end{aligned} \tag{10.1}$$

These two methods differ in the determination of allowable reserves, but if allowable reserves do not increase, both methods would reduce to the specific charge-off method. Allowable bad debt reserves are calculated by specific statutory formula. They do not correspond to banks' financial book income statement or regulatory bad debt reserves, which are based on the banks' and regulators' subjective judgment of the amount of funds necessary to cover current and future losses.

Percentage of Eligible Loan Reserve Method. Under the percentage of eligible loan (PEL) reserve method, a bank's allowable reserve equals a specified percentage, h_t, of its eligible loans, EL_t. The bad debt reserve deduction equals net charge-offs plus any addition to allowable reserve:

$$BDRD_t = (h_t * EL_t - h_{t-1} * E_{t-1}) + NCO_t \tag{10.2}$$

Again, with no change in allowable reserve, this reduces to the specific charge-off method. Eligible loans are limited to a bank's total loans less loans to financial institutions, FHA and VA insured loans, and commercial paper in order to prevent a reserve deduction for loans which have little or no default risk. The allowable percentage was 1.8 percent from 1969 to 1975, 1.2 percent from 1976 to 1981, 1.0 percent in 1982, 0.6 percent in 1983 to 1987. The PEL method is scheduled to expire at the end of 1987.[2]

An important provision of the PEL reserve method is the base year reserve grandfathering rule. Banks using the PEL method are allowed to maintain their existing reserve level after a decrease in the allowable percentage of eligible loans. This prevents a reduction in a bank's tax reserve which would result in inclusion of the reserve decrease in taxable income. For instance, a bank can maintain its reserve at 1 percent of 1982 eligible loans if it is higher than 0.6 percent of eligible loans in later years. For banks using the base year reserve (i.e., those banks with product of allowable percentage and eligible loan decreasing), the allowable reserve is constant, which leaves the PEL method effectively equivalent to the specific charge-off method. Because of the declining allowable percentage, a large number of banks were on the base year reserve during the late 1970's and mid-1980's.

Experience Reserve Method. Under the experience reserve method, the allowable bad debt reserve is the product of a bank's six-year moving average loan loss rate and its total loans. The experience reserve method was codified for banks in 1969 and is similar to the six-year moving average reserve method (the "Black Motor Formula") allowed for nonfinancial institutions' bad debt reserves before tax reform. The average loan loss rate, a_t, is the ratio of actual net charge-offs during the current and preceding five years to total outstanding loans during the current and preceding five years. The experience method reserve increases if total loans or the loan loss rate increases. As under the PEL reserve method, bad debt deductions equal increase in allowable reserves plus net charge-offs:

$$BDRD_t = (a_t * TL_t - a_{t-1} * TL_{t-1}) + NCO_t \tag{10.3}$$

b. Tax Reform

The Tax Reform Act repealed both reserve methods for bad debt deductions for "large" banks. Banks with more than $500 million in assets (or that are part of a consolidated group with more than $500 million in assets) must now use the specific charge-off method. "Small" banks may still use the experience reserve method and, until it scheduled expiration in 1988, the percentage of eligible loan method.

The bad debt reserve deduction was repealed for nonfinancial institutions as well as large banks. The reserve method generally accelerated deductions so they are received prior to the year in which the loss would be determined under the "all events test." Thus, bad debt losses were allowed more generous tax treatment than other expected future losses, such as product liability claims. Acceleration of future loss deductions is the equivalent of the government making interest-free loans to banks of the amount equal to the current tax rate time the amount of the existing tax reserve.

In addition to the change in bad debt deductions of "large" banks, the Act requires the recapture of their existing bad debt reserves into taxable income. In general, the recapture of existing tax bad debt reserves recognizes that banks have already deducted amounts added to reserves. If future charge-offs are allowed as deductions rather than as nondeductible charges to the reserve, then banks would be allowed double deductions for those losses. The existing reserve outstanding at the end of 1986 generally must be brought back into taxable income over 4 years: 10 percent in 1987, 20 percent in 1988, 30 percent in 1989, and 40 percent in 1990. The four-year recapture rule is thus more generous than requiring future losses to be charged to the reserve, which would have recaptured the reserve for most banks in two or three years.

Two exceptions are allowed to the recapture rule. First, "financially troubled" banks, which have nonperforming loans in excess of 75 percent of equity capital[3], can suspend the recapture of their existing reserve until they no longer meet this definition of financially troubled. Second, a bank may elect to include more than ten percent of its reserve balance in 1987 (or the first year of recapture). This may be advantageous to a bank with expiring net operating losses or subject to tax credit limitations. The remainder of the reserve must then be included in taxable income: 2/9th in the second year, 3/9th in the third year, and 4/9th in the fourth year.

The recapture of the existing tax bad debt reserves will have a major effect on "large" banks' tax liability during the recapture period. Approximately 90 percent of the expected tax revenue from repeal of the bad debt reserve method during fiscal years 1987 through 1991 is due to the recapture provision. However, it should be noted that most deductions for increases in the bad debt reserve were taken at 46 percent, while the recaptured reserves are be taxed at only a 34 percent rate. This is the equivalent of the banks borrowing $1 from the U.S. government at a zero interest rate and then only paying back 74 cents (34/46) upon recapture.

2. Disallowance of Interest on Debt Used to Purchase or Carry Tax-exempt Obligations

Before 1983, commercial banks deducted all interest paid on deposits and other borrowings irrespective of the amount of tax-exempt bonds held. Unlike corporations, banks have the ability to tax arbitrage. For example, a bank could earn after-tax profits by borrowing $100 at 10 percent (5.4 percent after-tax at a 46 percent tax rate) and investing in a tax-exempt bond yielding only 6 percent. On a pre-tax basis, this transaction results in a loss of $4, yet earns $0.40 after-tax. This rule also enabled banks to reduce their Federal tax liability nearly to zero by holding a small fraction of their assets in tax-exempt bonds.

For tax-exempt bonds acquired after 1982, pre-1986 law disallowed deductions for 20 percent of the interest on debt attributable to the purchase or carrying of tax-exempt obligations. The disallowance applied on a pro rata basis. If 10 percent of a bank's assets are tax-exempt bonds acquired after 1982, then 2 percent (10 percent times 20 percent) of interest deductions are disallowed.

The Tax Reform Act increases the disallowance percentage to 100 percent for tax-exempt bonds acquired after August 6, 1986. Exceptions are provided for public-purpose tax-exempt bonds issued by state and local government entities that expect to issue less than $10 million of such bonds during the year. Bank purchases of these issues, and bonds related to 20 specific projects listed in the Conference Report of the Tax Reform Act, are subject only to the 20 percent disallowance rule. Previously purchased tax-exempt bonds continue to have prior law treatment.

3. Special Rules for Net Operating Losses of Financial Institutions

Before the Tax Reform Act, financial institutions were allowed to carry net operating losses (NOLs) back to the prior ten taxable years and forward to the succeeding five taxable years. This special rule was adopted in 1969 to offset the effect of the phasing-down of the percentage of eligible loan bad debt reserve method. Nonfinancial corporations were only allowed to carry NOLs back 3 years and forward 7 years (15 years after the 1981 Act). The longer carryback period increased the likelihood that NOLs could be deducted in the current year rather than carried forward into future years.

Tax reform requires financial institutions to have the same 3 year carryback and 15 year carryforward rules as all other corporations. However, a special transition rule is allowed for commercial banks with NOLs attributable to deductions for losses on bad debts. Such NOLs occurring before 1994 can continue to be carried back 10 years.

B. General Tax Reform Provisions Affecting Commercial Banks

1. Corporate Rate Reduction

Tax reform reduces the top corporate tax rate from 46 percent to 34 percent. The new rate schedules are shown in Table 10.1.

2. Alternative Corporate Minimum Tax

Under prior law, corporations were potentially subject to an add-on minimum tax. Corporations had to pay 15 percent of certain preference items in excess of the greater of their regular tax liability or $10,000, in addition to their regular tax liability. The only bank-specific preference item was the excess of the percentage of eligible loan reserve method deduction over the experience reserve method deduction. By the 1980's most banks were not subject to the add-on corporate tax.

The Tax Reform Act repealed the add-on minimum tax and substituted a broad-based 20 percent alternative corporate minimum tax. The bad debt reserve preference item was retained as the excess over the experience method reserve

Table 10.1 **Corporate Tax Rate**

Taxable Income	Prior Law	1987	1988 and Beyond
		(percent)	
$25,000 or less	15	15	15
$25,000-$50,000	18	16.5	15
$50,000-$75,000	30	27.5	25
$75,000-$100,000	40	37	34
$100,000-$335,000	46	42.5	39
$335,000-$1,000,000	46	40	34
$1,000,000-$1,405,000	51	42.5	34
Over $1,405,000	46	40	34

deduction, but will be meaningless for banks after the expiration of the percentage of eligible loan reserve method after 1987. However, a number of preference items were added. The Act's most important preference item affecting banks is the inclusion of 50 percent of the excess of pre-tax book income over alternative minimum taxable income. "Business untaxed reported profits" are thus effectively taxed at a 10 percent tax rate. Tax-exempt interest income is the major difference between banks' book income and taxable income. No grandfathering of income from existing assets was provided, so banks' income from existing holdings of tax-exempt bonds will be subject to this tax. To the extent that book bad debt deductions exceed tax bad debt deductions, some of the tax-exempt income will continue to be fully sheltered from tax.

Two other elements of the alternative minimum tax are important to banks. First, only 90 percent of foreign tax credits and net operating losses are usable against the minimum tax. Amounts disallowed may be carried over to other taxable years. Second, minimum tax liability is allowed as a carryforward credit against regular tax liability to the extent attributable to deferral items. Minimum tax liability resulting from tax-exempt interest income, however, is not allowed as a carryforward credit.

3. Foreign Tax Credits

The Tax Reform Act made a number of changes to the foreign tax credit rules. Separate limitations for financial services income and interest income subject to high withholding taxes were included to prevent the "averaging" of domestic and foreign tax rates across different sources of income. Even with significant transition rules, over $1.1 billion in additional tax revenues in fiscal years 1987-91 are estimated from all corporations due to the separate limitation on interest subject to high withholding taxes.

4. Limitations on the Use of the Cash Method of Accounting

After tax reform, use of the cash method of accounting is not allowed for taxpayers with average annual gross receipts of $5 million or more. Additional income recognized in the first year from the required change in accounting methods must be included in taxable income over a 4-year period.

5. Investment Tax Credit and Depreciation Rules/Leasing

Tax reform repealed the investment tax credit and lengthened depreciation lives. These changes will affect depreciation deductions for banks' new physical assets (bank buildings. computers. etc.). but these account for a very small fraction of banks' total assets. A large amount of the banks' investment tax credits and depreciation deductions arise from their leasing activity. Some of the changes in the after-tax cost of leasing activity will be borne by the lessees.

III. THE BANK TAX SIMULATION MODEL

A. Overview of the Model

The banking model is designed to estimate the tax liability and after-tax profit under old law, under the Tax Reform Act of 1986, and under a variety of related proposals. There are four basic ingredients to the banking model:

- the Call Report data;
- extrapolation of the Call Report data;
- the bank tax calculator; and
- portfolio adjustment from tax-exempt to taxable bonds.

The banking tax model employs cross-section time-series regulatory accounting data. One advantage this data provides is the capability of calculating banks' tax bad debt reserves, which is the most controversial of all the tax reform provisions affecting banks. Available corporate tax return data does not include enough detail nor sufficient years of data to simulate effects of changes in allowable tax bad debt reserves. To calculate the percentage of eligible loan method reserve, FHA and VA real estate loans and loans to financial institutions are subtracted from total outstanding loans. To calculate the experience method bad debt reserve deduction in any year, data from the current and six previous years are required. Thus, to calculate the 1986 experience method reserve, data series beginning in 1980 are needed.

Several other new provisions cannot be estimated directly from tax data since relevant information had no bearing in the calculation of past tax liability. Book income, necessary for calculation of the new alternative minimum tax, was not recorded on tax returns, nor was tax-exempt income reliably reported. Both of these data items are directly available from book accounting data.

Due to the efforts of the industry's many regulators and unlike most other industries, consistent annual accounting data on nearly all firms is available for the banking sector. Our data set consisted of individual bank data for 1977 through 1984, the most recent available. These data are extended to 1985 and 1986 by extrapolating all variables from 1984 levels at the same rate as the industry's asset growth. Individual bank data is then extrapolated beyond 1986 at the same rate as forecasted nominal GNP.

The extrapolated individual bank data are used to calculate taxable income and alternative minimum taxable income. The first step in arriving at taxable income is the removal of state and local taxes and tax-exempt interest income from book income. The book provision for loan losses is added to book income, and estimated tax deductions for loan losses are subtracted. Most of these deductions are actual charge-offs and are directly available from the data. The remainder of the deductions are the addition to tax bad debt reserve.

Both the experience method and percentage of eligible loan method reserves are calculated for each bank and the largest is assumed to be the bank's chosen reserve.

For most large banks, no bad debt reserve deductions are allowed after 1986, and the outstanding tax reserve at the end of 1986 must be included in taxable income over the next four years. To calculate minimum taxable income, specified preference income and one-half of book income net of state and local taxes is added to taxable income. For each bank the graduated rate structure is applied to taxable income to arrive at regular tax liability and minimum taxable income is multiplied by 20 percent to arrive at alternative minimum tax liability. The greater of the two determines the bank's tax bill.

Banks currently have large tax-exempt holdings,[4] but lower tax rates and the total disallowance of deductions of interest to carry tax-exempts under tax reform are expected to virtually eliminate all new purchases of tax-exempt bonds by banks. Thus, in the tax reform simulations, banks' holdings of tax-exempt bonds are assumed to decline with a corresponding increase in investment in taxable assets. As taxable income replaces tax-exempt income, a large increase in tax liability occurs from this portfolio shifting. However, the negative effect of higher taxes on after-tax income is offset by the higher before-tax yields on taxable investments.

B. Call Report Data

Reports of Conditions and Income (Call Reports) must be filed by all banks that are either members of the Federal Reserve System, insured by the part of a bank holding company, or borrow at the Fed's discount window. The reports include detailed data on loans, loan commitments, securities, deposits, as well as general balance sheet and income statement data. These individual bank data are stored on magnetic tape by the Federal Reserve; aggregations of these data are published annually in the FDIC's Statistics on Banking. The commercial bank tax simulation model uses Call Report data for over 16,000 banks from 1977 to 1984.

There are, however, several disadvantages to using Call Report data to analyze the effect of tax reform. Information about foreign tax credits, investment tax credits, and tax depreciation are not available from the Call Reports. The investment tax credit and accelerated depreciation, which account for most of the discrepancy between statutory and effective tax rates for nonfinancial corporations, play a relatively minor role in the taxation of financial institutions. The omission of foreign tax credits is more serious, particularly for large banks.

An additional shortcoming is that many banks calculate taxes on a consolidated basis. Thus, income of groups of banks as well as nonbank businesses are consolidated on the same return. Call Reports, on the other hand, are prepared for regulators on an individual bank basis. To the extent that one bank's income is sheltered by losses of another bank or other businesses within a consolidated group, revenues calculated from Call Report data are overstated. A consolidated Call Report file, in which individual banks in a consolidated group are aggregated, was not available in time for this study. Even then, members of consolidated groups may elect to file separate returns.

C. Model Calibration

Despite the pains taken to reconcile book and taxable income, many adjustments necessary to achieve this goal could not be directly modeled because of incompleteness of the data. The resulting discrepancies between book and taxable income occur for several reasons. First, income from nonbank activities not reported to regulators are reported on the tax returns of banks that file consolidated returns with nonbank affiliates. Secondly, not all adjustments to book expenses to correct for larger corresponding tax deductions could be incorporated into the model. For example, the excess of tax over book depreciation deductions should be included in total tax deductions. Finally, as stated previously, banks file regulatory reports on an unconsolidated basis but may file tax returns with holding company affiliates. Thus, some banks may be able to shelter positive taxable income by filing a consolidated return with a bank that has losses. For all these reasons, it is not unexpected that taxable income computed by the model is different from that reported on tax returns.

These shortcomings do not greatly affect estimates of changes in bank-specific provisions. However, they are crucial in the estimations of the level of tax revenue and general tax provisions which depend on level of taxable income—namely, rate reduction and the alternative minimum tax. Unadjusted model estimates overstate the benefit to banks of rate reduction and underestimate the negative impact of the alternative minimum tax.

A two-step adjustment procedure has been employed to avoid these biases. Basically, this procedure attempts to reconcile model output to actual SOI data for the years 1980 through 1983, the latest year of aggregate tax return data available for this study. The average ratio of model to SOI total receipts from 1980 to 1983 is 1.21 and the corresponding average model to SOI total expense ratio is 1.27.[5] For the first-stage adjustment, total receipts and total expenses are multiplied by these factors. This eliminates the non-bank income and book/tax- accounting discrepancies described above.

When the model is run with these first-stage adjustments, although taxable income totals are substantially reduced, they remain above corresponding SOI figures for the 1980-1983 period. The remaining difference is due to joint filing of tax returns by profitable banks with banks reporting negative taxable income. This consolidation effect is not reflected in gross receipts or expenses. A correction to this model which uses unconsolidated data can be incorporated by adjustment to net taxable income. The average ratio of SOI taxable income to first-stage model taxable income for the 1980-83 period is 0.86. Accordingly, the second-stage model adjustment has taxable income for all banks multiplied by 0.86.

D. Extrapolation of Data

To extrapolate individual bank data to 1985 and 1986, most balance sheet and income statement items were increased from their 1984 levels by the industry's asset growth rate for 1985 and 1986. For 1987 through 1991, data was extrapolated by applying the Administration forecast of the growth of nominal GNP.[6] The growth rates applied to most data items for 1985 through 1992 are shown in the first line of Table 10.2. Extrapolations of charge-offs for loan losses, tax-exempt bond holdings, and tax-exempt interest income receive special treatment and are described below.

The calculation of the experience method reserve (and, therefore, the revenue effect of its repeal) is dependant upon to assumptions about future loan losses. Using unpublished FDIC data for 1985 and 1986, this growth rate of industry loan losses was assumed for individual banks. Industry or regulatory agency forecasts of future aggregate loan losses were not available. Loan losses depend on factors difficult to predict: the health of the agriculture and energy sectors; real estate values; whether poorly-performing loans to foreign governments will be charged-off; and unforeseen declines in other sectors. The baseline loan loss assumption predicts that the loan loss rate will return to pre-1980 levels. More pessimistic assumptions are evaluated in the sensitivity analysis in Section IV. All loan loss assumptions used are shown in the second panel of Table 10.2.

Historical experience as well as accounting relationships suggest a strong positive correlation between loan losses and the book accounting provision for loan losses. Thus, variation in loan losses generates variations in book provision for loan losses. Individual banks' provision for loan losses are assumed to equal 1.29 of their net charge-offs based on a linear least-squares regression of 1976-84 aggregate loan loss experience on net charge-offs.

Assumed percentage changes in bank holdings of tax-exempt securities are shown in the third panel of Table 10.2. As will be explained in detail in

Table 10.2 **Extrapolation Assumptions Used in Banking Model Simulations**

Calendar Year	1985	1986	1987	1988	1989	1990	1991
				(Percent)			
Baseline Growth Rate	8.9	3.3	6.5	7.2	7.2	6.9	6.4
Loan Loss Rate							
Baseline	.709	.828	.700	.600	.500	.400	.300
Static	.709	.828	.828	.828	.828	.828	.828
Pessimistic	.709	.850	.900	.900	.900	.900	.900
Change in Tax-Exempt Bond Holdings With Portfolio Adjustment	-21.5	-15.2	-27.3	-25.6	-22.5	-18.7	-16.0

Section III.F, large increases in bank holdings of tax-exempt bonds occurred at the end of 1985 in anticipation of tax reform, and a steady decline in their holdings are predicted after 1986. Total assets are still assumed to grow at the forecasted rate of GNP growth, but the composition of bank portfolios are allowed to change as a result of tax reform. Reduced holdings of tax-exempt bonds are mirrored by increased holdings of taxable securities.

E. Modeling of Tax Provisions

The bank tax simulation model estimates the tax liability and after-tax income of each commercial bank in the United States and sums these figures to estimate revenue. Several adjustments are made to book net income to arrive at regular taxable income and alternative minimum taxable income. First, tax-exempt income and state and local taxes are both subtracted from book income. Then the difference between a bank's book provision for loan losses and its the estimated tax bad debt reserve deduction is added. Finally, the graduated rate structure is applied to estimated regular taxable income of each bank and compared to 20 percent of the estimated alternative minimum taxable income. The larger amount is the bank's estimated tax liability.

1. Assignment of Tax Bad Debt Accounting Methods to Individual Banks

Before 1987 all commercial banks could use one of three methods for calculating bad debt deductions: the specific charge-off method, the percentage of eligible loans reserve method, or the experience reserve method. Banks were permitted to switch between the experience reserve method and percentage of eligible loans reserve method from year to year. Furthermore, banks were not required to reduce their bad debt reserve balance below a base year reserve as long as total loans outstanding did not decline. Until 1987, the base year reserve for each bank is its reserve in the last year it adopted the experience method; after 1988, the base year reserve is the 1987 reserve calculated under either method. The model assumes that each bank uses the method which provides the largest tax reserve.[7]

Table 10.3 **Estimated Use of the Experience Bad Debt Reserve Method**

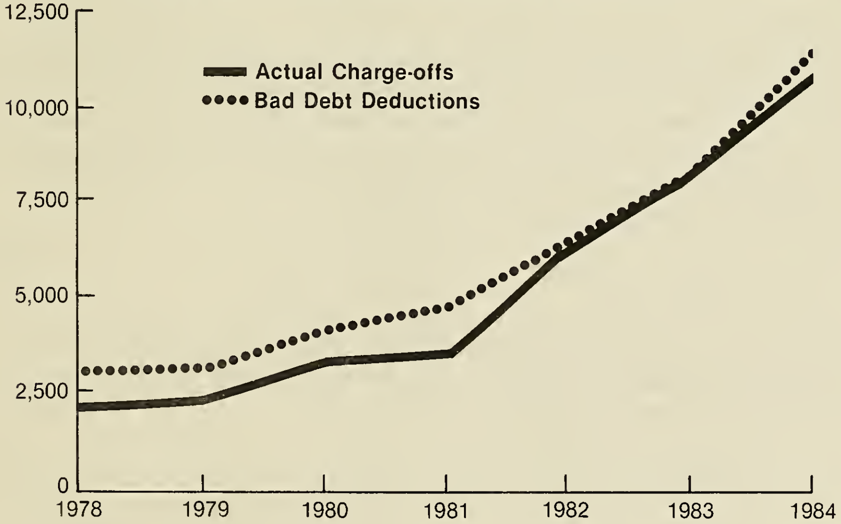
Calendar Year	1977	1981	1982	1983	1984	1985	1986
Number of Banks	294	376	679	1.382	2.605	3.755	4.377
Percent of Banks	2.0	2.6	4.7	9.6	18.0	26.0	30.3
Percent of Bank Assets	1.1	1.1	1.7	5.0	10.0	19.2	23.3

In the late 1970's and early 1980's, as the allowable percentage of eligible loans was phased down and as bank loan losses mounted, the model estimates that an increasing percentage of banks elected the experience method. As indicated in Table 10.3, only 2 percent of banks were estimated. As a result of tax reform, individual banks (or banks part of a consolidated group with more than $500 million in assets) are no longer allowed to include increases in their tax reserve as part of their bad debt deduction.[8] Tax deductions for loan losses, however, still result as specific charge-offs occur. Figure 10.1 shows the relationship between charge-offs and estimated tax bad debt deductions. The difference between the two, additions to tax bad debt reserve, have consistently been a small fraction of the total deduction for bad debts. For example, in 1984, only 5 percent, or $600 million, of $11.4 billion of estimated deductions for bad debt was attributable to use of the reserve methods; the other $10.8 billion was due to specific charge-offs.

2. Recapture of Existing Tax Bad Debt Reserve

Paralleling its treatment of the repeal of the reserve method, the model designates banks "large" (and therefore required to recapture existing tax bad debt reserves) only on the basis of individual bank asset size. For most banks with over $500 million in assets, 10 percent of their outstanding tax reserves at the end of 1986 are included in 1987 taxable income, 20 percent in

Figure 10.1 **Commercial Bank Actual Net Charge-Offs and Estimated Tax Bad Debt Deductions, 1978-1984**



1988, 30 percent in 1989, and 40 percent in 1990. If a bank's growth causes its assets to exceed $500 million in any year starting after 1987, then 10 percent of its tax reserve are recaptured in that year with 20, 30, and 40 percent recaptured in the following years. Due to lack of data on nonperforming loans the exception that allows "troubled" banks to defer recapture is not included in these simulations.

The Tax Reform Act allows large banks the choice of recapturing more than 10 percent of the existing tax reserve in the first year. Since it would be advantageous for a bank to shelter recaptured income with net operating losses, the model assumes that a bank accelerates recapture in 1987 (or its first year of recapture) if inclusion of 10 percent of tax reserve still leaves the bank with negative taxable income. For the following three years, banks taking accelerated recapture, in accordance with the Tax Reform Act, include 2/9's, 3/9's, and 4/9's of their remaining tax reserve in income.

3. The Corporate Alternative Minimum Tax

Tax reform replaces the corporate add-on minimum tax with an alternative minimum tax (AMT). Alternative minimum tax liability is generally due to the extent it is in excess of regular tax liability. A minimum tax rate of twenty percent is applied to the minimum tax base that includes regular taxable income (TI), specified tax preferences (PR), and one-half of business untaxed reported profits:

$$\text{Tentative Minimum Tax} = 0.2 * [\ \text{TI} + \text{PR} + 0.5{*}\text{BURP}\ ] \qquad (10.4)$$

where BURP is the excess of book income, net of state and local taxes, over regular taxable income and minimum tax preference items. The only preference income other than BURP included is the excess of bad debt reserve deductions over deductions allowable under the experience reserve method, which is only relevant for small banks in 1987. In the model, business unreported profits consist entirely of tax-exempt interest and the difference between tax bad debt deductions and book provision for loan losses.

F. Bank Portfolio Reallocation to Taxable Securities

For banks paying the regular tax at rate u and not subject to the alternative minimum tax, the net after-tax interest advantage of tax-exempt bonds compared to taxable securities is:

$$i_e - (1-u)*i_t - u*b*r \qquad (10.5)$$

where i_e is the tax-exempt rate rate, i_t is the rate on alternative taxable bank investments, b is the nondeductible percentage of interest expense attributable to carrying tax-exempts, and r is average interest rate on all bank interest-bearing liabilities.

Banks find tax-exempt bonds more attractive:

- the higher the tax-exempt interest rate, i_e;
- the lower the rate on alternative assets, i_t;
- the lower the average interest expense, r;
- the lower the proportion of interest which is nondeductible, b;
- the greater the corporate tax rate, u.

Tax reform repeals the deductibility of interest used to carry newly purchased tax-exempt bonds and lowers the top statutory corporate tax rate from 46 to 34 percent. Both changes make tax-exempt bonds less attractive relative to taxable investments. Banks prefer taxables to tax-exempts by a wide margin with these two changes in effect. Tax-exempt rates relative to taxable rates must rise far in excess of their historical levels for banks to purchase new tax-exempt securities.

Tax-exempt bonds are even less attractive investments for banks facing the alternative minimum tax. For banks subject to the alternative minimum tax, the net after-tax interest advantage of tax-exempt bonds compared to taxable securities is:

$$0.9*i_e - 0.8*i_t - 0.2*b*r \tag{10.6}$$

The 100 percent disallowance of interest attributable to tax-exempt securities, the 10 percent minimum tax on tax-exempt interest income, and the lower marginal tax rate each reduce the incentive for new purchases of tax-exempt securities by banks.

This analysis suggests that, except for qualified small issues, banks will not make new purchases of tax-exempt securities. Furthermore, banks will not sell tax-exempt bonds purchased before August 7, 1986. Despite lower tax rates, bonds purchased before tax reform remain a good deal. When old securities mature, banks will replace them with taxable investments.

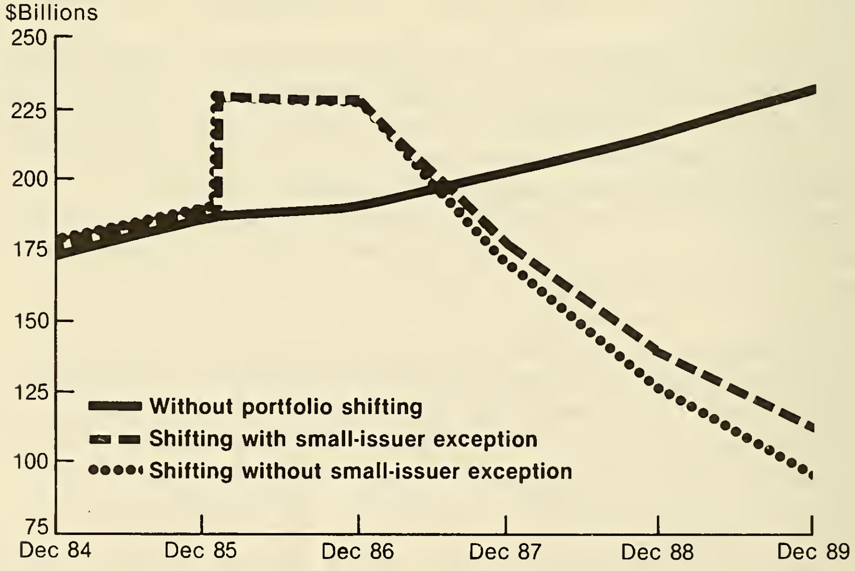
In addition, tax reform had anticipation effects on bank purchases of tax-exempt securities. The tax law prompted banks to purchase extra tax-exempts before they lost their special tax treatment. The House tax reform bill slated the new law to take effect January 1, 1986. During December of 1985 commercial banks increased their tax-exempt bond holdings by approximately 20 percent. The exception for new purchases of bonds supplied by small-issuers and special projects combined with these eleventh hour purchases considerably dampened the aggregate effect of the 100 percent disallowance rule. Preliminary estimates indicate that the supply of qualified bonds will equal roughly 20 percent of what bank demand for tax-exempt bonds would have been without the 100 percent disallowance rule.

In simulations of tax reform, all banks' tax-exempt bonds holdings are reduced by the same percentage, shown in Table 10.2.[9] Then, to maintain balance sheet consistency for each bank, taxable investments are increased by exactly the decline in tax-exempt bonds. Figure 10.2 shows the banking industry's tax-exempt bond holdings in 1984 and 1985 and estimates for later years under three different scenarios. Line (1) represents the expected growth of bank holdings of tax-exempt securities with no changes in the tax law. The jump at the end of 1985 depicted in lines (2) and (3) represents the actual increase in the holdings of tax-exempt securities by banks, presumably in response to an anticipated January 1, 1986 effective date for the new tax law. To estimate retirements of banks' August 1986, information on the maturity structure of banks tax-exempt bond holdings was used. Line (3) shows the industry's holdings decline with maturation of existing bonds and without any purchases of qualified small issues. Beginning at the end of 1986, line (2) shows the decline in tax-exempt holdings which include bank purchases of 'qualified' small issues. Line (2), taking into account extra purchases at the end of 1985 and new purchases of bonds from small issuers after 1986, represents the portfolio shifting in the simulations of tax reform.[10]

IV. SIMULATION RESULTS

The banking model was used to simulate the changes in banks' Federal tax liability and after-tax income from 1987 through 1991 due to the revisions most affecting banks. The overall effect of tax reform is an increase of $5.3

Figure 10.2 **Commercial Bank Holdings of Tax-Exempt Loans and Securities**



Assumes "qualified" issues are 20 percent of new issues purchased by banks with no portfolio shifting. Runoffs of new and existing issues are based on maturity structure of 1982 tax-exempt holdings.

billion over the five year period in the Federal income tax liability of commercial banks. Nevertheless, banks are net "winners" from tax reform. Despite their paying more Federal taxes, after-tax income increases by over $6.1 billion over five years due to rate reduction and higher pre-tax incomes from altered investment portfolios.

The model examines five major changes in the tax law and their interactions. The two general corporate tax changes are varied from column to column in Table 10.4: (a) the new rate structure and (b) the new alternative minimum tax. Three banking- specific changes and combinations thereof are varied from row to row: (1) the repeal of the bad debt reserve method for large banks, (2) the recapture of existing bad debt reserves into taxable income for large banks, and (3) the disallowance of deductibility of interest to carry tax-exempt securities.

A. General Corporate Provisions

The primary benefit of tax reform to banks is rate reduction. The reduction of the top corporate rate from 46 to 34 percent by itself would reduce

Table 10.4 **Effect of Tax Reform Provisions on Banks' Federal Tax Liability and After-Tax Income Between 1987 and 1991, Total 5-Year Changes**[a]

	Without Alternative Minimum Tax		With Alternative Minimum Tax	
	46% Rate	34% Rate	46% Rate	34% Rate
		($Billions)		
(0) Changes Only in Regular Tax Rate and/or Minimum Tax				
Revenue	0	-5.76	1.59	-3.69
After-tax Income	0	5.76	-1.59	3.69
(1) Repeal of Bad Debt Reserve Method				
Revenue	0.03	-5.73	1.61	-3.67
After-tax Income	-0.03	5.73	-1.61	3.67
(2) Recapture of Bad Debt Reserve				
Revenue	2.84	-3.66	3.35	-1.90
After-tax Income	-2.84	3.66	-3.35	1.90
(3) Disallow Deductibility of Interest Allocable to Tax-Exempt Bonds				
Revenue	11.83	3.08	11.86	3.14
After-tax Income	-0.17	8.58	-0.20	8.52
(4) Changes (1), (2), and (3) Combined				
Revenue	15.09	5.49	15.11	5.53
After-tax Income	-3.43	6.17	-3.45	6.13

[a] Except for the second and third columns of Row (0) and the first column of Rows (1) to (3), these figures represent changes from current law due to combinations of tax law changes.

commercial bank taxes by $5.8 billion over the first five years of tax reform. Besides this direct benefit to banks, rate reduction lessens the impact of tax reform base-broadening measures, because each additional dollar of taxable income yields 34 instead of 46 cents in revenue. In the following sections, the benefits of rate reduction are weighed against the base-broadening provisions which raise bank tax liabilities.

The effects of the alternative minimum tax (AMT) can be observed by comparing the first and third columns and the second and fourth columns in Table 10.4. With no base broadening, the AMT increases tax liabilities by $1.6 billion under the pre-tax reform rate structure and $1.9 billion dollars with lower rates during 1987 through 1991.

The alternative minimum tax for banks is largely a function of the difference between book and taxable income because banks do not have a large amount of preference income. Recapture and repeal of the bad debt reserve method increase taxable income do not significantly reduce the alternative minimum tax. However, the large amount of portfolio switching to taxable securities, which increases taxable income by more than it increases book income, reduces much of the potential impact of the alternative minimum tax on banks. Once banks shift their portfolios toward more taxable securities few banks will have minimum tax liability. This is consistent with our earlier assertion that banks maximize after-tax income by holding enough taxable securities so that regular tax liability equals minimum tax liability.

B. Provisions Specific to Banking

By comparing rows (0) and (1) in Table 10.4 it can be seen that repeal of the bad debt reserve method for large banks increases taxes by less than $0.1 billion under the new rate structure. The effect is small since the banks will continue to deduct net charge-offs which have been about 95 percent of tax bad debt deductions. Excess bad debt deductions have been reduced due to the phasedown and future expiration of the percentage of eligible loans method and the base year grandfathering rule which put many banks or the equivalent of the specific charge-off method.

The revenue impact of the recapture of large banks' existing tax bad debt reserves can be calculated by comparing rows (0) and (2) of Table 10.4. Under lower rates, recapture increase banks' tax liability increases by $1.8 billion over the five year period. An important distinction to make between the repeal of bad debt reserve methods and recapture is that the former is a permanent change while most of the revenue impact of recapture takes place during the 1987-1990 period.

The effects of commercial banks' shifting from tax-exempt to taxable securities due to the disallowance of interest for carrying tax-exempt securities can be calculated by comparing rows (0) and (3) in Table 10.4. Under new rates and the alternative minimum tax, portfolio shifting increases bank taxes by $6.7 billion. Nevertheless, after-tax income increases by $4.8 billion.[11]

How is it possible that banks pay more taxes yet will still be better off?

The switch to taxables is induced primarily by two factors: rate reduction and the disallowance of interest expense. However, although both these changes have the same behavioral effect, they have opposite impacts on the banks' bottom line. A switch to taxables will increase banks' taxable income and thus tax liability, but because taxable investments have higher yields than tax-exempt bonds, banks' extra tax burden is offset by higher pre-tax yields. This explains why tax increases are greater than reductions in after-tax income. However, with rate reduction after-tax yields on taxables may exceed tax-exempt yields and the portfolio switching would increase after-tax income.

The interest disallowance causes banks to switch to taxable investments, increases tax liability, and reduces after-tax income (first and third columns in row (3) in Table 10.4). This occurs because after-tax returns from taxable investments at a 46 percent rate are lower than tax-exempt yields. Rate reduction increases after-tax returns from taxable securities so that when banks switch to taxables and increase their taxes, banks could experience an increase in after-tax income assuming the implicit tax rate remains constant at 33 percent on tax-exempt bonds acquired in the future, as can be seen in the second and fourth columns in row (3) of Table 10.4.

C. The Effects of Tax Reform over Time and on Small and Large Banks

The $5.5 billion in additional tax revenue shown in the lower right corner of Table 10.4 is not evenly spread over the 1987-91 period. The last panel of Table 10.5 shows that tax reform lowers the banking industry's tax liabilities by $0.4 billion in 1987. Taxes increase after 1987 as banks increase their purchases of taxable investments; by 1991 banks have an additional $12.6 billion of taxable income due to portfolio shifting. Taxes also tend to rise from 1987 to 1990 as the percentage recapture of existing bad debt reserves increases.[12] Thus, relative to prior law, taxes rise from 1987 through 1990, drop in 1991 with the decline in recapture, and then resume their rise as banks continue to substitute taxables for maturing tax-exempts. The effect of tax-reform on after-tax income is relatively stable until 1991 when it jumps from $1.2 billion to $2.3 billion due primarily to the reduction of recapture from $3.2 billion in 1990 to $0.5 billion in 1991.

Just over one-quarter of the banking system's assets in 1986 were held by banks with less than $500 million in assets. Comparison of the first two panels of Table 10.5 indicates that $3.2 billion of the total increase of $6.2 billion in after-tax income flows to small banks. This larger than proportionate increase is not unexpected since small banks are not affected by recapture or repeal of the bad debt reserve method. Nevertheless, disproportionate revenue is also derived from small banks; collectively, small banks pay $2.4 billion in extra taxes while large banks only pay $3.1 billion more than under prior law over the five-year period. This is due to small banks' relatively large holdings of tax-exempt securities; these banks earned just

Table 10.5 **The Effects of Tax Reform on Small and Large Commercial Banks, by Year, 1987-1991**

Calendar Year	1987	1988	1989	1990	1991	Total
			($ Billions)			
Banks with Less Than $500 Million in Assets						
Additional Taxable Income:						
Reserve Recapture	0.00	0.00	0.00	0.00	0.00	0.00
Reserve Method Repeal	0.00	0.00	0.00	0.00	0.00	0.00
Portfolio Adjustment	0.22	1.92	3.62	4.97	6.05	16.78
Change in Tax Liability	-0.08	0.14	0.46	0.80	1.11	2.43
Change in After-Tax Income	0.16	0.50	0.75	0.86	0.90	3.16
Banks with Greater Than $500 Million in Assets						
Additional Taxable Income:						
Reserve Recapture	3.47	1.59	2.40	3.20	0.46	10.71
Reserve Method Repeal	0.95	0.68	0.49	-0.16	-0.51	1.44
Portfolio Adjustment	0.24	2.08	3.92	5.39	6.55	18.19
Change in Tax Liability	-0.28	-0.19	0.90	1.49	0.80	3.10
Change in After-Tax Income	0.36	0.50	0.41	0.31	1.39	2.97
All Commercial Banks						
Additional Taxable Income:						
Reserve Recapture	3.47	1.59	2.40	3.20	0.46	10.71
Reserve Method Repeal	0.95	0.68	0.49	-0.16	-0.51	1.44
Portfolio Adjustment	0.46	4.00	7.55	10.37	12.60	34.97
Change in Tax Liability	-0.36	0.33	1.36	2.29	1.91	5.53
Change in After-Tax Income	0.51	1.00	1.16	1.16	2.29	6.13

under one-half of tax-exempt interest income in 1984. In sum, small banks are bigger winners than large banks.

D. The Effect of Tax Reform Under Alternative Scenarios

Alternative loan loss scenarios were discussed in Section 3 and displayed in Table 10.2. Although it was originally expected that different loan loss assumptions would have a significant impact on after-tax income, model simulations under different scenarios did not confirm our suspicion. Under the "static" scenario, where the loan loss rate remains constant at the record 1986 level of 0.828, net charge-offs would total $86.7 billion over the 1987-1991 period as opposed to $52.0 billion in the model baseline extrapolation;

therefore, by 1991 the experience reserve method tax reserve would have grown to $22.6 instead of $17.3. Under the worst-case "pessimistic" scenario where the aggregate loan loss rate rises to 0.9 percent in 1988 and remains at that level through 1991, net charge-offs would total $93.3 billion over the 1987-91 period and by 1991 the experience reserve method tax reserve would have grown to $22.8. However, these increases of $5.4 and $6.5 billion in taxable income only translate respectively into $0.5 billion and $0.6 billion in extra taxes. These low effective average tax rates occur because firms with large losses have little taxable income and pay little tax anyway. The alternative minimum tax has little impact since increases in loan losses reduce book income by almost as much as the reduction in taxable income.

V. FUTURE EXTENSIONS OF THE BANKING MODEL

The current version of the banking model is designed to provide revenue estimates and serve as a tool for analysis of the major provisions of the Tax Reform Act of 1986 that affect commercial banks. This section outlines potential model improvements for more refined estimates.

A. Tax Provisions Not Included

The primary reason for not modeling specific provisions is lack of data. The usual suggested correction for this problem is to estimate for each bank the missing data item from that bank's data where the relationship is determined from other information. This section lists shortcomings of the model, resultant biases, and potential improvements.

1. Foreign Tax Credits

Modeling foreign tax credits requires information about foreign taxes and foreign income. Alternatively, extrapolations of 1983 SOI tax return data could be undertaken. Non-inclusion of this provision causes U.S. taxes to be higher than they would be otherwise. Foreign tax credits are most advantageous to large banks with overseas income. Since tax reform reduces foreign tax credits, the revenue increases under tax reform. especially for large banks, will be larger than shown in these simulations. The separate FTC limitation for income subject to gross withholding greater than 5 percent is estimated to yield an additional $1.1 billion in tax revenue over the 1987-91 period.

2. Investment Tax Credits and Accelerated Depreciation

Estimating investment tax credits and accelerated depreciation requires information about tangible investment that is not available in current Call

Report data set. The repeal of the ITC and reduction in depreciation deductions increases the tax liabilities of all banks, and this increase in tax liability is not captured in these simulations.

3. Carryforwards and Carrybacks

The model should have banks with tax losses building up stocks of unused NOLs and using them in years with positive taxable income. In general, the non-inclusion of carryforward and carryback provisions causes tax liabilities to be overstated. In addition, tax liabilities of any one bank will have more variance over time. (Offsetting current taxable income with unused NOLs will smooth out peaks in tax liability.) The change in carryforward and carryback provisions under tax reform will cause banks to carryforward, rather than carryback, more losses which reduces the present value of the losses. The estimated revenue effect from the change was only about $0.1 billion in 1987-91.

4. The "Troubled Bank" Exception

Banks with high percentages of nonperforming assets are allowed to suspend recapture of tax reserves into income until the quality of their loan portfolio improves. Thus, these simulations recapture bad debt reserve into taxable income more quickly than will actually occur. This causes the simulation revenue estimates of tax reform to be too high in the early years and too low in later years. Estimates indicate that the troubled bank exception will reduce revenue by $0.5 billion over the 1987-91 period.

5. Other Excluded Provisions

As stated earlier, these simulations allow banks with less than $500 million in assets on an individual basis continued use of the reserve method (and also no recapture). This treatment overstates the extent of the small bank exception. Thus, the change in revenues in these simulations is understated.

In addition, repeal of the cash method of accounting was also not modeled. Repeal of the cash method of accounting for banks was estimated to raise about $0.5 billion between 1987 and 1991.

B. Extrapolation Features Not Included

More elaborate extrapolation techniques would improve individual company estimates but have not yet been incorporated in the model. These include non-uniform growth rates for different firms and different balance sheet and income statement items, and consistent treatment of balance sheet and income statement accounts.

Even if there were a high-degree of confidence in the forecast of aggregate growth of bank assets and liabilities, revenue estimates are sensitive to how this growth is distributed among firms. More realistic revenue estimates would include a distribution of growth rates for individual firms consistent with forecasted aggregate growth.

Growth of all assets and liabilities by the same aggregate rate, as is assumed in these simulations, maintains balance sheet consistency for each firm. However, banks may change the composition of their balance sheets while growing at the aggregate asset growth rate. The model maintains balance sheet consistency in the case of changes in portfolios from tax-exempt to taxable securities, but assumes equal growth rates for all other assets.

If corporate profits are targeted at one growth rate and certain income or expense items, such as the provision for loan losses, are assumed to grow at different rates, assumptions about the growth rates of other income and expense items must be made which are consistent with each bank's income identity. Currently, the model does not employ a general mechanism to reconcile disparate growth rates of income statement items.

Several balance sheet items, such as provision for loan losses and depreciation, have direct effects on the balance sheet. Conversely, income (or expense) flows from asset (or liability) stocks should be consistent with reasonable assumptions about rates of return. For example, if interest-bearing assets grow by ten percent and interest rates are expected to rise, interest income can be expected to grow by more than ten percent.

C. Shortcomings of Forecasts

Aside from the issues surrounding the question of the proper extrapolation techniques, revenue estimates rely heavily on forecasts of target variables. The key target variable in these simulations is total bank assets. Bank asset growth is affected by macroeconomic conditions which are in themselves difficult to forecast. However, in addition, as outlined above, many non-macroeconomic factors may affect industry growth. Relaxation and/or tightening of various regulations of not only banks but their competitors will affect the future of commercial banking. Similarly, taxation of current or potential banking competitors or innovation in financing technology or techniques could affect the banking industry's share of total financial services income.

To the extent that tax reform increases after-tax income of banks, growth of the banking sector should be expected. All these factors add uncertainty to forecasts of commercial bank assets. However, although errors in forecasts greatly affect the level of bank profits and taxes, the difference in after-tax profits and taxes due to tax reform (i.e. revenue estimates) will be considerably smaller because the marginal tax rate is less than 100 percent.[13]

VI. SUMMARY AND CONCLUSION

Base-broadening provisions specific to banks–namely, the repeal of the bad debt reserve method, the recapture of existing bad debt reserves into taxable income, and the disallowance of interest costs used to carry-tax exempts securities–are commonly highlighted when assessing the effects of the tax reform on banks. However, empirical analysis with a model using individual bank data shows that the added tax liability due to these provisions, along with the alternative minimum tax, is offset largely by rate reduction.

Although banks on the whole pay more taxes over the 1987-91 period, the banking industry's after-tax income increases because additional interest income will be earned when banks shift their portfolios to taxable securities. Taxable securities earn higher yields than tax-exempt securities, and, because of tax reform, they are taxed at lower rates.

APPENDIX

DERIVATION OF CONDITIONS FOR HOLDING TAX-EXEMPT SECURITIES

Banking Facing Regular Tax

Abstracting from the important considerations of risk and liquidity, a bank with only two assets picks the level of each (and implicitly, by the balance sheet constraint, total liabilities) in order to maximize after-tax profit. A firm subject only to regular tax and not the minimum tax has an after-tax profit function:

$$\begin{aligned} P &= i_e * TE + i_t * BA - i_D * DD - OC - \\ &\quad u * \{ i_t * BA - [i^D * DD - b * IE * TE/(TE+BA)] - OC \} \qquad (10.A1) \end{aligned}$$

where P = after-tax profit;
TE = holdings of tax-exempt securities;
BA = holdings of other (taxable) loans and securities;
DD = bank liabilities;
OC = noninterest costs;
i_e = interest rate on tax-exempt securities;
i_t = interest rate on other assets;
i_D = interest rate on bank borrowing (deposits);
u = statutory corporate tax rate;
b = the percentage of interest expense disallowed;
IE = total interest expense = $i_D * DD$.

By using the balance sheet identity to eliminate BA (=DD-TE) from the profit function (10.A1), differentiating with respect to TE, and setting the derivative equal to zero, the net-after tax interest advantage of tax-exempts compared to taxable securities is:

$$i_e - (1\text{-}u)*i_t - u*b*r \qquad (10.A2)$$

where r = interest expense as a fraction of total assets (= IE/TA). Banks purchase tax-exempt bonds only if (10.A2) is positive. According to equation (10.A2) if taxable bonds earn 9 percent interest and bank average interests expense is 6 percent, under pre-tax reform law tax-exempt bonds yielding only 5.4 percent (or 60 percent of the comparable taxable yield) would be preferred to taxable investment. After-tax reform tax-exempt rates would have to rise to 8.0 percent (or 88.4 percent of comparable taxable yield) to be attractive to banks.

Banks Facing the Alternative Minimum Tax

A bank subject to the new alternative minimum tax has the profit function:

$$\begin{aligned} P &= (i_e *TE + i_t *BA - i_D *DD - OC)*(1\text{-}0.5*m) - m*PR \\ &\quad - 0.5*m * \{i_t *BA - OC - [i_D *DD - b*IE*TE/(TE+BA)]\} \qquad (10.A3) \end{aligned}$$

where

m = the minimum tax rate (= 20 percent);
PR = dollar amount of preference income.

Again, by substituting the BA+TE for DD, differentiating with respect to TE, and setting the derivative of profits equal to zero, the net advantage of tax-exempts over taxable securities for banks subject to the minimum tax can be derived:

$$i_e * (1\text{-}0.5*m) - i_t *(1\text{-}m) - 0.5* m *b *r \qquad (10.A4)$$

For banks with taxable investments earning 9 percent, an average interest expense of t percent and an alternative minimum tax rate of 20 percent, the tax-exempt rate would have to rise above the taxable rate of 8.7 percent for its after-tax yield to exceed that of taxable investment for banks.

FOOTNOTES

[1] See Joint Committee (1984) and Marovelli (1986).

[2] It should also be noted that the 1982 Tax Act reduced the benefit of PEL reserve method by disallowing 15 percent of the excess of the PEL method deduction over the allowable deductior

computed under the experience reserve method. The disallowance was increased to 20 percent for tax years after 1984. The disallowance affected few banks due to the phase-down of the allowable percentage and to the base year reserve.

[3] Nonperforming loans or loans that are either 90 or more days past due, "nonaccrual loans" or "renegotiable troubled debt." Equity capital means the equity of a bank as defined for regulatory purposes. It does not include any book reserve for loan losses.

[4] At the end of 1984 banks held over $170 billion in tax-exempt investments. Banks with assets size of less than $300 million had tax-exempt holdings equal to 9.6 percent of their assets. while the larger banks held only had 6.1 percent of their assets in tax-exempt investments.

[5] The two first stage adjustment factors and the second data adjustment factor was calculated as follows:

	1980	1981	1982	1983	Average
Ratio of SOI to unadjusted model output:					
Total Receipts	1.14	1.19	1.27	1.26	1.21
Total Expenses	1.19	1.24	1.32	1.31	1.27
Ratio of SOI to first-stage model output:					
Net Taxable Income	0.91	0.67	0.89	0.95	0.86

[6] Before-tax book profits of the banking industry as a percentage of GNP were 0.55 in 1976. increased to 0.71 in 1979 and 1980, and declined to 0.55 in 1984. Bank profits over this period generally moved with interest rates; however, deregulation of deposit rates will reduce the positive correlation between bank profits and interest rates. In addition, other structural changes in commercial banking make profits difficult to forecast. Repeal of the Glass-Steagall Act would allow banks to enter other activities. most notably, investment banking, which may increase the banking industry's total profits in the long-run, but not necessarily in the near future. Income from service charges will increase banks profits. while increased competition from other intermediaries (e.g., credit unions, thrifts) and financial instruments (e.g., commercial paper, collateralized mortgage obligations) may reduce profits.

[7] The assumption is consistent with after-tax profit maximization, if tax minimization results from acceleration of deductions. Banks may not want to accelerate deductions if they expect that tax rates they may increase or that loss carryforwards from deductions might expire.

[8] As mentioned above, Call Report data is only available on an unconsolidated basis. In the banking model, banks eligible for the small bank exception are defined as those individual banks with less than $500 million in assets. This overstates the percentage of industry assets to which the small bank exception applies.

[9] A later paper extends the model to include endogenous financial portfolio holdings of commercial banks with more detailed specification of banks' tax-exempt bond holdings. See Neubig and Sullivan (1987).

[10] This differs from the standard treatment in revenue estimation of pre-enactment effects described in Howard Nester's "A Guide to Interpreting the Dynamic Elements of Revenue Estimates" in Chapter 1 of this volume. Consistency with the revenue estimating methodology would require including the end-of-1985 surge in purchases of tax-exempt securities in the baseline simulation.

[11] The estimated change in after-tax income is sensitive to the estimated future tax-exempt taxable yield ratio. The estimates in the paper assume taxable yields are 150 percent of comparable tax-exempt yields. If the yield differences narrow. then the change in after-tax income would be smaller.

[12] In the calculation of tax revenue low average effective tax rates apply to the large amount of recapture in 1987 since $2.8 billion of the total of $3.5 billion is accumulated by firms with no current tax liability that are assumed to have opted to accelerate recapture.

[13] As a simple example, consider a revision of industry five-year profits from $140 to $130 billion. The effect of the revised forecast on the revenue estimate of a rate change (if all firms were fully taxable at the top rate) from 46 to 34 percent would be a revision of the revenue loss figure from $16.8 to $15.6 billion.

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11 THE USE AND ABUSE OF RENTAL PROJECT MODELS

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I. INTRODUCTION

During consideration of the Tax Reform Act of 1986 (TRA86), housing analysts relied heavily on rental project models to support their arguments for more or less generous tax treatment of residential and commercial rental property. These models derive the rent level that would provide an investor with an assumed required rate of return given a set of assumptions about an investment's economic and tax characteristics. Despite the sophistication of these models, or perhaps because of it, analysts predicted widely varying effects of tax reform proposals.[1] How could analysts using similar models in evaluating a tax reform bill whose characteristics were easy to represent parametrically produce such variant analyses?

The purpose of this paper is threefold. First, we describe what rental project models are and discuss a particularly useful model that has been developed at the Office of Tax Analysis (OTA). Second, we show how these models can be used to gain valuable insights about how tax and non-tax factors affect individual investors, and about the implications for efficiency and equity of various tax policies. Finally, we answer the question posed above. We show that the wide range of results is due to inherent and fatal flaws in rental project models as tools for forecasting market-wide responses to tax policies.

Many other economists have contributed to development of rental project models at OTA. They are, in roughly chronological order, Frank DeLeeuw, Larry Ozanne, Harvey Galper, Eric Toder, Larry Dildine, Steve Sheffrin, Jim Nunns, Joe Cordes, and Hudson Milner. We are grateful to Joe Cordes, Don Fullerton, Tim Goodspeed, Hudson Milner, Jim Nunns, Joel Slemrod, Marty Sullivan, Eric Toder, and Jenny Wahl for helpful comments on earlier drafts and Vicky Conway for assistance in the preparation of the manuscript and tables.

II. WHAT IS A PROJECT MODEL?

A. DEFINITION

A project model simulates the cost and income streams that would be generated by a long-lived investment under a set of assumptions about taxes, the economic environment, and the characteristics of the investor. Early simple models were designed to help investors decide whether a particular investment was worthwhile. More sophisticated variants of this kind of analysis, such as the OTA model, can determine endogenously how long investors should hold properties, break-even rents, and sales price streams. Analysts at OTA have used project models to study the effect of tax changes on investments in real estate, timber, oil drilling, mining, and other assets.

B. KINDS OF RENTAL PROJECT MODELS

This section describes three kinds of rental project models that are used by investors and housing analysts: the spreadsheet model, the "initial investor" model, and a dynamic programming model. While the first two kinds of models are the most widely used, they are not well suited to representing the effects of anticipated future tax laws on the resale value of a property and may thus be misleading. Section III will describe the more sophisticated dynamic model that has been developed by OTA.

1. Spreadsheet Models

Table 11.1 illustrates a simple spreadsheet model for a hypothetical real estate investment. The spreadsheet provides a convenient way to evaluate a project under various assumptions about taxes and economic conditions. The left column lists the assumed parameters that underlie the analysis. It should be noted that, although this list of assumptions is extensive, more complicated models depend on even longer lists of assumptions. The advantage of this kind of model is that it is simple (models like this could be developed in any spreadsheet program on almost any microcomputer), easy to develop, and easy to use.

The simple example in Table 11.1 represents a low-income housing unit under conditions that might have prevailed in 1985 (pre-TRA86). The investor/developer is assumed to hold the project for 15 years, which is the length of the ACRS low-income housing depreciation schedule.[2] The nominal value of the land allocated to the property is assumed to increase at a constant rate (3% per year) over the 15 years. The nominal structure value is constant because inflation in structure values is assumed to just offset economic depreciation. The initial rent is assumed to be 10% of value ($4,100) and initial operating costs are assumed to be 2.5% of the structure value. Both grow at a constant annual rate of 3%.

Table 11.1 Sample Spread Sheet Calculator for ACRS Low-Income Housing

Investment Assumptions	
Purchase	
Land	$5,000
Structure	$30,000
Total Price	$35,000
Rehabilitation	
Percentage	20.0%
Dollar Cost	$6,000
New Basis	$36,000
Total Cost	$41,000
Mortgage	
Interest Rate	11.0%
Term (years)	30
% Borrowed	90.0%
Loan Amount	$36,900
Payment	$4,244
Transaction Costs	
Percentge	3.0%
Dollar Cost	$1,050
Initial Investment	$5,150

Parameters	
Depreciation Rate	3.0%
Operating Cost/Value	2.5%
Initial Rent	$4,100
Rent Inflation	3.0%
Land Inflation	3.0%
Structure Inflation	3.0%
Discount Rate	8.0%
Discount Factor	92.6%
Tax Rate	50.0%
Capital Gains Rate	20.0%

Generated Stream of Income and Deductions for Rental Property

Year	Rent	Operating Costs	Mortgage Principal	Interest	Tax Deprec.	Taxable Income	Pre-Tax Cash Flow	Tax Benefit	After-Tax Income
1	$4,100	$900	$36,900	$4,059	$5,100	-$5,959	-$1,044	$2,980	$1,935
2	$4,223	$927	$36,715	$4,039	$4,800	-$5,543	-$948	$2,771	$1,823
3	$4,350	$955	$36,509	$4,016	$4,200	-$4,821	-$850	$2,411	$1,561
4	$4,480	$983	$36,280	$3,991	$3,900	-$4,394	-$748	$2,197	$1,449
5	$4,615	$1,013	$36,027	$3,963	$3,600	-$3,961	-$643	$1,981	$1,338
6	$4,753	$1,043	$35,745	$3,932	$2,100	-$2,322	-$535	$1,161	$626
7	$4,896	$1,075	$35,433	$3,898	$1,800	-$1,877	-$423	$938	$515
8	$5,042	$1,107	$35,086	$3,859	$1,500	-$1,424	-$309	$712	$403
9	$5,194	$1,140	$34,701	$3,817	$1,500	-$1,263	-$191	$632	$441
10	$5,350	$1,174	$34,274	$3,770	$1,500	-$1,095	-$69	$547	$478
11	$5,510	$1,210	$33,800	$3,718	$1,200	-$617	$56	$309	$365
12	$5,675	$1,246	$33,273	$3,660	$1,200	-$430	$185	$215	$400
13	$5,846	$1,283	$32,689	$3,596	$1,200	-$233	$318	$117	$435
14	$6,021	$1,322	$32,040	$3,524	$1,200	-$25	$455	$13	$467
15	$6,202	$1,361	$31,320	$3,445	$1,200	$195	$596	-$98	$498
16			$30,521						
PVs	$41,727	$9,160		$33,188	$24,337	-$24,958	-$3,763	$12,479	$8,716

Computation of Gain or Loss on Sale (Undiscounted)	
+ Sale Price	$43,790
- Mortgage Principal	-$30,521
- Transaction Costs	-$1,314
- Capital Gains Tax	-$4,953
= Net Return	$7,003

Present Value of Returns to Investment		
Initial Cost	-$5,150	
Income Stream	$8,716	
Gain on Sale	$2,208	
Net Return	$5,774	112.1%
Gross Return	$10,924	212.1%
Coupon Equivalent	$1,087	21.1%

Future values are risky. Rents and operating costs are affected by vacancy rates, how well the tenants care for the units, and actual inflation rates. The project model implicitly assumes that the income and cost streams represent expected values and that risk may be accounted for in the discount rate (or rates[3]) at which the investor discounts future income.

The simple model produces many of the outputs of other more complicated models. It summarizes the investor's cash flows through the assumed life of the project. It computes the present value of benefits, with detail about the value of tax incentives. This spreadsheet reports a variant on the internal rate of return–the "equivalent coupon rate"[4]–which represents for a tax-exempt bond with the same face value, risk, and term as the project, the rate of interest that would generate the same present value. For this hypothetical project, the coupon equivalent is 13.8%.

The model is sensitive to a large number of assumed parameters. Results depend critically on the discount rate and the marginal tax rate of the investor. For example, accelerated depreciation and other tax deductions are most valuable to investors in high tax brackets. In tax-shelter investments, higher leverage (i.e., higher loan-to-value ratio) generates larger interest deductions, which increase the amount of income that can be sheltered from tax. Thus, the initial loan-to-value ratio as well as assumptions about refinancing are important. Finally, with highly leveraged investments, the interest rate is more important than any other parameter.[5]

2. Initial Investor Models

A drawback of the simple model as a policy tool is that it cannot determine the effect of tax policies on how long to hold the rental project.[6] Good tax policy attempts to minimize tax-motivated distortions in taxpayers' decisions to buy or sell assets. But the simple spreadsheet provides no direct information about how investors' selling or holding decisions might respond to tax changes. In a seminal work, DeLeeuw and Ozanne (1979) developed a more complex model that included endogenous determination of the holding period. We call this kind of model the "initial investor" model because it simulates the economic decisions of the first investor to hold a rental project.[7]

An initial investor model is a straightforward extension of the simple model. Given an exogenous stream of sales prices for each year during the life of the project, the model solves for the holding period that maximizes the present value of after-tax cash flows. Initial investor models are especially useful for studying how capital gains taxes, depreciation recapture provisions, marginal tax rates, and inflation affect churning[8] of real estate.

3. Dynamic Models

A shortcoming of initial investor models is that they cannot capture the effect of tax changes on future owners. To accomplish this, OTA has developed a dynamic programming model in which sales prices and holding periods are determined endogenously and simultaneously.[9] An advantage of this kind of model is that it shows how future tax benefits can be capitalized into property values.

III. THE OTA RENTAL HOUSING PROJECT MODEL

The OTA rental housing project model is an extension of the types of models described above. The OTA model can run as either a dynamic model or as an initial-investor model (which allows easy comparison of the alternative methodologies). The model includes as options all of the major features of tax laws and proposals pertaining to rental housing made since the 1981 Tax Act. It allows for accounting peculiarities that help distinguish various tax laws, such as half-year accounting and variable-length construction periods. The appendix describes the mechanics of the model.[10]

A. MEASURES OF RETURN ON INVESTMENT

The model can compute one of three different summary measures of return on investments. By default, the calculator finds the user cost of rental housing capital, defined to be the initial period's rent as a proportion of value that sets the initial investor's net present value equal to zero. This measure is sometimes referred to as "required rent".[11] The OTA model can also determine the internal rate of return on the first investor's equity, holding rates of return for subsequent investors constant. In another mode, the calculator can find the real after-tax rate of return that would drive the net present value for all investors (including the mortgagor) to zero given an exogenous rent level. This measure represents the equilibrium market rate of return given the assumed parameters. Finally, the calculator can simply compute the present value of the project to the initial investor given exogenous rents for the exogenous holding period.

1. User Cost

The user cost measure provides a concise summary of the effects of various tax and non-tax parameters in a single number. The model can thus be used to estimate, for a given tax law, how user costs are distorted among investors with different marginal tax rates and how tax shelter provisions affect user costs. A sequence of model runs can determine how much each of a set of tax provisions affects the cost of rental housing (for a given investor), and how those provisions interact. The model also shows how transaction costs and other non-tax factors affect user costs.

2. Internal Rate of Return

The internal rate of return (IRR) is another useful measure of capital costs for rental housing. Given a fixed rent stream, the IRR indicates how real after-tax rates of return for investments of comparable risk would have to change to make the particular investment attractive (or unattractive). This measure provides interesting insights into how rates of return vary across tax brackets. For example, it appears from the model that tax shelter investors may demand higher rates of return than small-scale landlords.[12] This suggests that the tax shelter investors have higher opportunity costs of capital, perceive more risk in their investments, or have higher operating costs than the smaller investors, or, perhaps, some combination of the three. The IRR is used in the model to compute effective tax rates, as discussed below.

3. Net Present Value

The net present value (NPV) indicates how tax law provisions might be capitalized into the value of the rental property, holding the rent stream and after-tax rates of return constant. This measure is more powerful than might appear at first glance because the model computes sales prices and holding period endogenously. Thus, net present value comparisons not only show the present value of direct tax benefits or costs incurred by the initial investor, but include how taxes are capitalized into the resale value of the property as well as how taxes affect the timing of sale. The initial investor model would ignore this latter component.

The three measures may be used to infer the limits of tax incidence for a particular kind of housing held by a particular kind of investor. The user cost, IRR, and NPV, indicate the effect on renters, capital, or land holders in the case where each of them, respectively, is assumed to bear the entire burden of a tax. If all other prices are constant and there is free entry and exit from the market, then rents for a new building held by the hypothetical type of investor would be driven to the level of the user cost in equilibrium (if the type of investor were participating in the market). Alternatively, if rents, land prices, and the amount of equity capital are fixed, then real after-tax returns on equity would equal the IRR. Finally, if the quantity of land is fixed and all other prices remain constant, then changes in the computed NPV represent changes in land prices (subject to a nonnegativity constraint).

B. EFFECTIVE TAX RATES

1. Measuring Effective Tax Rates

A logical extension of the rental project model is computation of effective tax rates on rental housing investment. The calculator prints three measures of effective tax rate defined by Bradford and Fullerton (1981) based on internal rates of return. The three measures are the effective gross rate

(t_g), the effective net rate (t_n), and the tax wedge (t_w). The gross rate is essentially taxes as a percentage of gross (before-tax) income, the net rate is taxes as a percentage of net (after-tax) income, and the wedge is taxes as a percentage of asset value. They are defined as follows:

$$t_g \equiv \frac{r_b - r_a}{r_b}, \tag{11.1}$$

$$t_n \equiv \frac{r_b - r_a}{r_a}, \text{ and} \tag{11.2}$$

$$t_w \equiv r_b - r_a, \tag{11.3}$$

where r_b and r_a are the before- and after-tax rates of return, respectively.[13] The property-tax rate is treated as a user charge (a la Tiebout), rather than as a tax, for purposes of computing r_b.

The effective gross rate, t_g, is the closest analogue to what is typically thought of as a tax rate. However, as Bradford and Fullerton point out, this measure yields peculiar results when the before-tax rate is close to zero or negative. When r_b is zero, t_g is undefined, and when r_b is negative, t_g has the wrong sign and can be very large. So what is, in fact, a large tax subsidy (which is why r_b can be negative) is reported as a large positive effective tax rate.

Since the after-tax rate is usually positive, the effective net tax rate, t_n, may be more appropriate, but care should be taken in its interpretation. Tax rates as a percentage of net income are always larger than gross rates whenever net rates of return are positive. For example, a 50% statutory rate of tax on gross income corresponds to a 100% tax rate relative to net income because tax equals after-tax net income.

The tax wedge, t_w, may be the most robust estimator, in the sense that it is never undefined or ill-defined. But, again, care must be taken in comparing this measure to statutory tax rates.

2. Implementation in the OTA Model

It is both an advantage and a disadvantage of the approach taken here that the internal rate of return is used as a measure of returns to capital investment. The advantage is that the measure is independent of the assumed discount rate of the investors. The disadvantage is the general problem that internal rates of return do not always give consistent rankings of streams of income and expense when the internal rate varies greatly from the actual discount rate.[14] A related problem is that the IRR may be inconsistent with the user cost, sales prices, and holding periods that are derived assuming particular discount rates. Furthermore, some streams of income may have no internal rate of return, or the IRR may not be unique. A possible alternative approach would be to compute effective tax rates using before- and after-tax present values.

The effective tax rates are computed for the equity portion of the investment as well as for all capital invested in the project. The effective rate on the whole investment is useful for analyzing the tax burden on rental housing capital and for comparison with tax rates on other forms of capital. This type of measure would typically be used in analysis of the efficiency aspects of a tax policy change.

The effective tax rate on equity shows the effect of taxes on the equity part of an investment holding taxes on debt constant. This measure might be relevant if equity in rental housing is considered to be a different kind of financial instrument than debt, perhaps because of risk. Of course, in equilibrium, taxes on debt should be reflected in the cost of borrowing and thus affect the rate of return on equity.

Effective tax rates are computed separately for each owner and cumulatively for the project through each successive holding period. The separate computations by owner are helpful in comparing the tax treatment of new and used buildings. The cumulative effective tax rate provides a summary measure of the level of tax or subsidy for the project over its entire economic life.

Finally, we should note that computation of effective tax rates as described above addresses the concerns of Summers (1987) in his recent working paper. He criticized Treasury's published effective tax rates on structures as being too high because they do not account for the capitalization of future tax benefits or the higher leverage that is possible with structures. But the OTA Rental Housing Project Model correctly accounts for both of these features.

3. Effective Tax Rates for a Pre-TRA86 Investment

Table 11.2 illustrates the different effective tax rates computed by the OTA model for a rental housing investment made in 1985. The first section of the table displays internal rates of return for each of three owners of an ACRS rental housing investment assuming that rents are set so that all equity investors earn a 4% real after-tax rate of return. This requires that after-tax returns be positive and well defined, but the large tax incentives in pre-TRA86 law allowed a project with negative before-tax returns on equity to be profitable after taxes. The result is that for all but the last investor, the effective gross tax rate is not meaningful (indicated by NA, not applicable). The effective net tax rate and the tax wedge, however, provide consistent comparisons of the value of tax subsidies in each case.

The table shows that in the case of a depreciating building with moderate inflation (the assumed project turns to dust after 50 years), the value of tax subsidies declines with each owner. The value of depreciation deductions falls as a percentage of each investor's purchase price as the value of land increases relative to structure value. The effective net rates in the table

Table 11.2 **Three Measures of Effective Tax Rates for a Rental Housing Investment in 1985**[a]

	Rates of Return		Effective Tax Rates		
	Pre-Tax	After-Tax	Gross Rate	Net Rate	Tax Wedge
For Each Owner					
Equity Only					
Owner 1	-.0073	.0400	NA[b]	-1.183	-.047
Owner 2	-.0007	.0400	NA	-1.018	-.041
Owner 3	.0115	.0400	-2.482	- .713	-.029
Asset (Debt & Equity)					
Owner 1	.0422	.0400	.052	.055	.002
Owner 2	.0460	.0400	.131	.151	.006
Owner 3	.0593	.0400	.325	.482	.019
Investment to Date					
Equity Only					
Through Owner 1	-.0073	.0400	NA	-1.183	-.047
Through Owner 2	-.0049	.0400	NA	-1.124	-.045
Through Owner 3	-.0041	.0400	NA	-1.103	-.044
Asset					
Through Owner 1	.0422	.0400	.052	.055	.002
Through Owner 2	.0430	.0400	.069	.074	.003
Through Owner 3	.0434	.0400	.079	.086	.003

[a] Non-low-income ACRS housing investment. Rent set so all investors earn zero net present value. Default parameter values (see appendix): e.g., discount rate = 4%, 80% loan-to-value ratio, tax rate = 40%, inflation = 5%, interest rate = 12%. User cost is 9.23%; three owners' holding periods are 19, 19 and 12 years, respectively.

[b] NA = not applicable.

show that tax subsidies amount to 118.3% of the first investor's net return, but only 71.3% of the last owner's. Looked at another way, the tax wedge shows that tax subsidies augmented the rate of return on investment by 4.7% for the first investor, but only 2.9% for the third.

When considering the overall subsidy or tax on rental housing it is appropriate to include debt. The example that generated Table 11.2 was 80% debt-financed for each investor. Including debt, all three measures of effective tax rate are positive. The effective gross tax rates range from 5.2% to 32.5%.

The second section of Table 11.2 presents cumulative effective tax rates. The rates "through owner 3." represent the overall effective tax rates on the project through its entire life. The line in the equity-only portion shows that tax preferences account for more than 100% of the return on equity, even accounting for the smaller subsidy on the last investor. The asset row. however, suggests that the investment as a whole is subject to a small positive effective tax rate on gross income (7.9%).

IV. APPLICATIONS OF RENTAL PROJECT MODEL ANALYSIS

Like many of the tools in an economist's kit, rental project models are most useful for their qualitative results. Since the model represents a possible decision making strategy (based on maximizing expected present value) for a single investor considering a particular project in a hypothetical economic and tax environment. the model's quantitative results do not apply to the economy as a whole. However, it is very useful for tax policy purposes to be able to study how an existing or proposed policy would affect individuals' behavior in isolation from the myriad other factors that tend to confound analysis. Thus the model allows for a kind of controlled experiment.

The model results can be generalized to market-wide phenomena in some cases. Certain qualitative results. such as higher user costs or longer holding periods, might prove to be robust when parameter values are varied between the extremes of their feasible ranges. However. even in these cases, conclusions about the market levels of economic variables (notably rents) cannot be made solely on the basis of rental project model results. Section V expands on the limitations of project model analysis.

Nonetheless, a rental project model is very useful for evaluating tax policies on a micro level. This section illustrates some applications of the OTA Rental Project Model.

A. TAXES AND CHURNING

It would be inefficient and undesirable if the tax system were to encourage investors and landlords to sell rental real estate before they would have in the absence of taxes. A primary economic benefit of having a large and heterogeneous rental market is that it economizes on the very large costs that characterize real estate transactions. Landlords typically hold real estate much longer than the average tenant's occupancy, so individuals who expect a short tenure in a home find it less expensive to rent than to own.

In the absence of taxes, and assuming perfect credit markets (so that investors could borrow against the accumulated value of their real estate), the model predicts that transaction costs would prevent rental property holders from ever selling. Since transaction costs represent real resource costs, this kind of "lock-in" effect is efficient. However. as Tables 11.3A and 11.3B show, before the passage of TRA86. investors would tend to choose shorter holding periods as tax rates increase. This result is qualitatively robust with respect to changes in assumed parameter values.

Churning was profitable under the Economic Recovery Tax Act of 1981

Table 11.3A **Effect of Marginal Tax Rates on Rental Housing Investment (Pre-TRA86 Parameters[a])**

Investor's Tax Rate (%)	User Cost (%)	Percentage of No Tax User Cost	Holding Period (Years)	Number of Owners	Net Effective Tax Rate Equity (%)	Net Effective Tax Rate Investment (%)	Average Debt-Equity (%)
No Taxes[b]	8.79%	100.0%	50	1	0.0%	0.0%	39.1%
0%	10.44%	18.8%	50	1	0.0%	39.8%	41.2%
15%	10.22%	116.3%	50	1	-9.5%	34.4%	41.3%
28%	9.94%	113.1%	19	2	-70.5%	23.7%	62.4%
33%	9.68%	110.1%	19	3	-88.5%	16.9%	62.7%
50%	8.39%	95.4%	19	3	-173.9%	-16.2%	63.9%
70%	5.48%	62.3%	18	3	NC[c]	-99.9%	70.1%

[a] See Table 11.8 for values. Tax rates vary as indicated.
[b] Tax rate on debt is also zero. Interest rate on debt falls to 9% to yield 4% real rate.
[c] NC = not computable. There is not internal rate of return for which the investor's before-tax present value equals zero (i.e. pre-tax income is negative in every year).

Table 11.3B **Effect of Marginal Tax Rates on Rental Housing Investment (TRA86 Parameters[a])**

Investor's Tax Rate (%)	User Cost (%)	Percentage of No Tax User Cost	Holding Period (Years)	Number of Owners	Net Effective Tax Rate Equity (%)	Net Effective Tax Rate Investment (%)	Average Debt-Equity (%)
No Taxes[b]	8.79%	100.0%	50	1	0.0%	0.0%	39.1%
0%	10.02%	113.9%	50	1	0.0%	29.6%	40.7%
15%	10.02%	113.9%	50	1	0.2%	29.7%	40.9%
28%	10.02%	113.9%	50	1	0.4%	29.8%	41.0%
33%	10.02%	113.9%	50	1	0.5%	29.9%	41.1%
50%	10.02%	113.9%	50	1	1.0%	30.1%	41.5%
70%	10.02%	113.9%	50	1	2.2%	30.7%	42.7%

[a] See Table 11.8 for values. Tax rates vary as indicated.
[b] Tax rate on debt is also zero. Interest rate on debt falls to 9% to yield 4% real rate.

(ERTA) and the 1982 and 1984 Tax Acts because of the greatly accelerated depreciation for residential real estate. Rental real estate owners in high tax brackets could earn valuable tax deductions in the early years of a project's life. Thereafter, the project became much more valuable to a new purchaser than to the original owner because each new owner could claim new accelerated depreciation deductions. Moreover, with inflation there would be a "step up in basis" each time the property changed hands. Were it not for recapture penalties,[15] owners would have sold even sooner.

Capital gains taxes tend to distort holding patterns in the opposite direction. Hendershott and Ling (1985) used a project model to explore the effect of inflation and taxes on churning of real estate held as a tax shelter. They reported that capital gains taxes tended to reduce the incentive to sell real estate offsetting somewhat the perverse incentives of accelerated depreciation. As inflation increased (holding real after-tax interest rates constant), Hendershott and Ling found that the lock-in effect intensified, even for high tax bracket investors. This is because the effective tax rate on real capital gains increases with inflation, so investors find deferral of gain more profitable.

In light of these findings, we would expect TRA86 to reduce churning significantly for residential (not low-income[16]) real estate. The Act lengthened the depreciation schedule from 19-year 175% declining-balance to 27.5-year straight-line, reduced tax rates, and repealed the partial exclusion of capital gains income from tax. The first part of Table 11.4A shows that, under one set of reasonable assumptions, rate reduction or repeal of the capital gains exclusion would be expected to end churning, which is optimal in the context of the rental model.

The conclusion that tax reform would result in optimal churning is not robust with respect to changes in parameter values, however. Under a set of assumptions that might be more characteristic of a tax-shelter investor, churning is reduced, but not ended, by the provisions of tax reform. Table 11.4B considers a top-bracket investor who is more highly leveraged and who discounts future income at a higher rate than the hypothetical investor in Table 11.4A. Table 11.4B also assumes somewhat lower interest rates. Under this scenario, tax rate reduction alone would not be sufficient to affect churning among individuals in the top brackets. Lengthening the depreciation schedule actually shortens the holding period for the first investor to fifteen years. However, repealing the exclusion for capital gains would lengthen the optimal holding period for the first investor from 19 to 26 years. The TRA86 provisions, taken as a whole, result in a holding period of 25 years.

These results suggest two conclusions. First, the Tax Reform Act of 1986 should substantially reduce churning for most types of rental real estate.[17] Assuming that refinancing is costly, these results are robust with respect to other assumptions about the characteristics of the taxpayer and the economy. The second important conclusion is that some kinds of results are very sensitive to small changes in parameter assumptions. The sensitivity of model results is discussed in V.B.

B. COMPARATIVE EFFECT OF TAX REFORM PROVISIONS ON RENTAL USER COSTS

Table 11.4A and Figure 11.1 show how the non-low-income residential rental housing tax provisions affect the user cost for a hypothetical investor. They show both the effects of each provision separately as well as the incremental effect of adding one more provision (in a particular order) to the last.

Table 11.4A **Effect of Tax Reform Provisions on User Costs Stacked Separately and Together Compared to 1985 Law (Assumptions I)**

	Stacked First Against 1985 law				Stacked Against Previous Provisions			
	User Cost	% Change from Baseline	No. of Owners	Holding Period of First	User Cost	% Change in User Cost	No. of Owners	Holding Period of First
1985 law[a]	9.23%	0.0%	3	19	9.23%	--	3	19
27.5 year straight-line depreciation	10.10%	9.4%	3	19	10.10%	9.4%	3	19
Tax rate reduction[b]	10.08%	9.2%	1	50	10.39%	2.9%	1	50
Non-exclusion of capital gains	9.62%	4.2%	1	50	10.40%	0.1%	1	50
Lower interest rates[c]	8.74%	-5.3%	3	19	9.99%	-3.9%	1	50
Capitalize CPIT	9.26%	0.3%	3	19	10.02%[d]	0.3%	1	50
Passive loss limitation[e]	11.08%	20.0%	2	29	10.36%	3.4%	1	50

[a] Assumes marginal tax rate of 40% for equity investors, 25% on debt, discount rate of 4%, mortgage interest rate of 12%, inflation rate of 5%, 80% leveraged.

[b] Marginal tax rate is 22% for equity investors, 20% on debt.

[c] Interest rate = 11.25% (yields 4% real after-tax return after rate reduction on debt).

[d] TRA86.

[e] Assumes no offsetting passive income so no losses are currently deductible.

Table 11.4B **Effect of Tax Reform Provisions on User Costs Stacked Separately and Together Compared to 1985 Law (Assumptions II)**

	Stacked First Against 1985 law				Stacked Against Previous Provisions			
	User Cost	% Change from Baseline	No. of Owners	Holding Period of First	User Cost	% Change in User Cost	No. of Owners	Holding Period of First
1985 law[a]	8.79%	0.0%	3	19	8.79%	--	3	19
27.5 year straight-line depreciation	10.56%	20.2%	3	15	10.56%	20.2%	3	15
Tax rate reduction[b]	10.80%	22.9%	3	19	11.60%	9.8%	3	21
Non-exclusion of capital gains	9.42%	7.2%	2	26	11.76%	1.4%	2	28
Lower interest rates[c]	8.04%	-8.5%	3	18	10.97%	-6.7%	2	25
Capitalize CPIT	8.82%	0.3%	3	19	11.01%[d]	0.4%	2	25
Passive loss limitation[e]	12.21%	38.9%	2	26	11.43%	3.8%	2	27

[a] Assumes marginal tax rate of 50% for equity investors, 25% on debt, discount rate of 8%. mortgage interest rate of 10%. inflation rate of 3%, loan-to-value = 90%

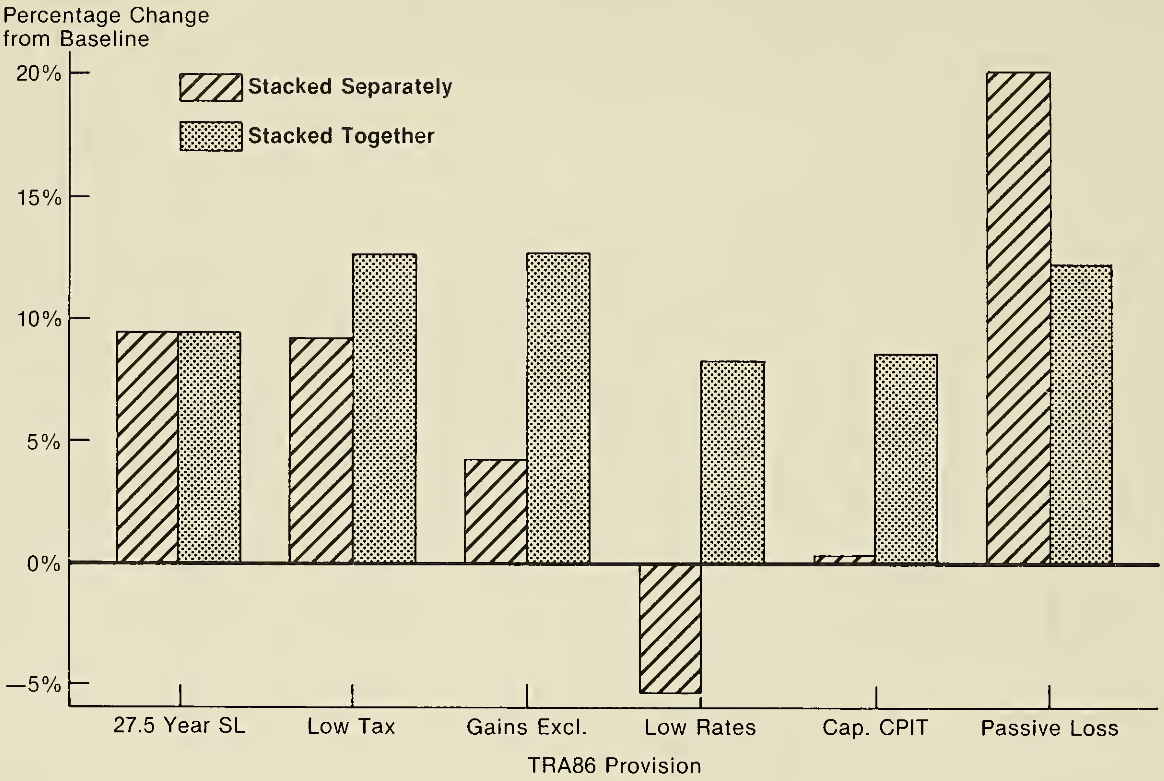
[b] Marginal tax rate is 28% for equity investors, 20% on debt.

[c] Interest rate = 9%

[d] TRA86.

[e] Assumes no offsetting passive income so no losses are currently deductible.

Figure 11.1 **Effect of TRA86 on User Costs**



Aside from the passive loss limitation, which will only affect certain investors, the most important single provision is the lengthening of the depreciation schedule. Were that the only reform, user costs for this hypothetical investor would increase by 9.4%. Reduction of marginal tax rates alone would increase user costs by 9.2% and repealing the exclusion for long-term capital gains would raise user costs by 4.2%.

The total impact is far less than the sum of its parts. After lengthening the depreciation schedule, the decrease in marginal tax rates has a very small effect on user costs, raising them by only 2.9%. With depreciation more closely approximating economic depreciation and with higher rents, there are few "paper losses" to deduct, so the tax rate of the investor diminishes in importance. Similarly, with lower tax rates, repeal of the capital gains exclusion becomes virtually irrelevant. While repealing the exclusion alone would raise user costs by 4.2%, full taxation of capital gains adds only 0.1% to user costs after tax rate reduction.

General equilibrium model analyses generally predict that TRA86 will reduce equilibrium market interest rates. (See e.g., Fullerton, Henderson, and Mackie, 1987). Table 11.4A shows that, in conjunction with other major provisions of TRA86, a 75 basis point decline in interest rates reduces user costs less than it would have under old law. Stacked on top of the other provisions, lower interest rates reduce user costs by 3.9% compared to 5.3% relative to the prior law baseline.

This is an interesting, and perhaps counterintuitive, result that illustrates the subtle interactions of tax revisions in a dynamic context. Because TRA86 curtails churning of rental housing, rental housing investments become far less leveraged on average. As a result, interest becomes a much smaller part of total costs. Thus a reduction in interest rates has a smaller effect on costs under TRA86 than it would have had under prior law.

One might expect that interest rate reduction would have a greater effect on user costs at lower tax rates, because the after-tax cost of debt increases. But user costs reflect before-tax rent levels. At the lower tax rates of TRA86, a one percent reduction in rents costs more after tax than before TRA86. Since lower tax rates raise both after-tax interest expense and after-tax rent, the direct effect of interest rate reduction should not depend on interest rates. Thus, the indirect effect through reduced churning dominates.

Much has been made of the effect of the passive loss limitation on real estate investors. Tables 11.4A and 11.4B show that the passive loss limit has far less impact in the context of TRA86 than it would have if adopted under prior law tax rates, depreciation rules, and interest rates. The separate provision would have raised the 1985 user cost by 20% in the example. However, the passive loss limitation would add only 3.4% when stacked on top of other TRA86 provisions. Under pre-TRA86 law, a passive loss limitation would have nullified the benefits of accelerated depreciation since tax losses would have been deferred until the time of sale. However, the reforms in

TRA86 combined with lower interest rates substantially reduce tax losses, so the passive loss limit has little effect.

C. TAX RATES, TAX REFORM, AND USER COSTS

Both ERTA and TRA86 significantly reduced top marginal tax rates. In 1988, when TRA86 is fully phased in, the top rate will be less than half of the 1980 maximum. With the tax incentives in pre-TRA86 law, investors in high tax brackets faced much lower user costs and effective tax rates for rental housing than investors in lower tax brackets. The Tax Reform Act of 1986, by scaling back the tax incentives and lowering marginal tax rates, removes those disparities. This provides both efficiency and equity gains. With approximately equal effective tax rates, high tax bracket investors will not be earning super-marginal returns. Furthermore, low and high bracket investors will have more equal access to real estate investments. Since accelerated depreciation provides the most valuable tax incentives to households in high tax brackets, tax rate reduction alone would have reduced much of the disparity in rates of return.

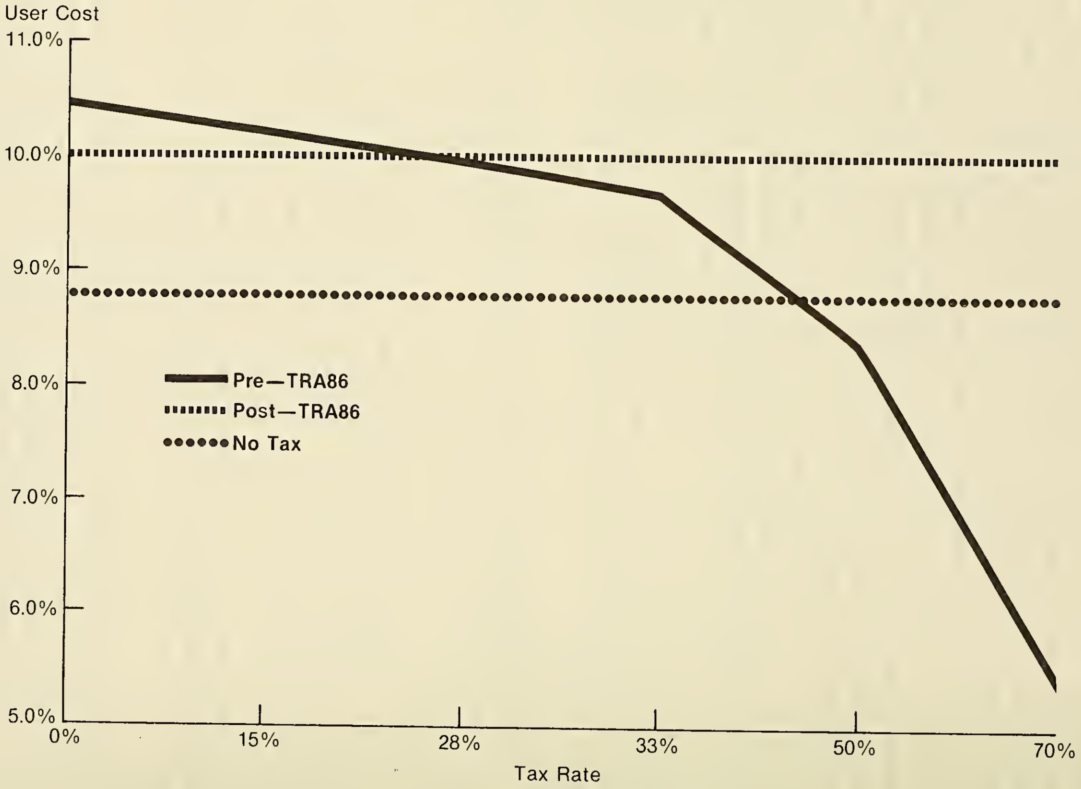
Tables 11.3A and 11.3B show for 1985 law how the cost of capital as well as several other summary indicators vary with marginal tax rates. In 1985 (Table 11.3A), a nontaxable investor faced the highest user cost of capital (10.44%) while the same investor would have a user cost of 8.39% (19.6% lower) if he were in the top tax bracket. If the pre-ERTA top rate of 70% had applied in 1985 the top-bracket investor's user cost would have been approximately half that of the non-taxable investor. Similarly, the net effective tax rate on equity varied from -173.9% for the 50% bracket investor to 0 for the nontaxable investor.

Simply reducing the top tax rate would substantially reduce this disparity. At a top rate of 33%, the disparity in user costs is cut by nearly two-thirds to 7.3%. The lowest effective tax rate is increased in absolute value terms to -88.5%.

Table 11.3B shows that the combination of residential real estate measures in the Tax Reform Act of 1986 obliterates the wide discrepancies between high-tax and low-tax investors. Effective tax rates become slightly positive for investors in every taxable income class. Because of longer depreciation and the repeal of the capital gains exclusion, the nontaxable investor becomes the least-cost investor by a small margin. If we were to further assume that the top-bracket investor were subject to the passive loss limitation, his or her user cost would become significantly greater than the untaxed investor's cost.

These data are illustrated in Figure 11.2. Before TRA86, user costs fell precipitously with marginal tax rates. But after TRA86, the relationship is virtually flat. (For comparison, the user cost that would apply in equilibrium if both lenders and real estate investors were exempt from tax is also shown.) At least for the baseline set of parameters, tax reform seems to have

Figure 11.2 Effect of Tax Rates on User Cost



succeeded dramatically in "leveling the playing field" among the various income classes of investors in rental housing.

It is important to point out that the quantitative conclusions are dependent on parameter assumptions. At lower discount rates or higher inflation rates, for example, the effective tax rates and user costs would be different. However, the qualitative results about the disparity in user costs and rates of return are robust with respect to different parameter assumptions. It is clear that tax reform will tend to place investors in different tax brackets on a much more even footing than under pre-1986 law.[18]

D. THE VALUE OF LOW-INCOME HOUSING TAX INCENTIVES

Table 11.5 compares the value of tax incentives for low-income rental housing before and after enactment of the Tax Reform Act of 1986. The table includes the value of tax-exempt bonds and the more generous ACRS depreciation schedule and expensing of construction period interest and taxes available in 1985. After tax reform, a credit of 4% per annum for ten years is available for low-income housing purchases and 9% per annum for ten years for new investment. A certain percentage[19] of units must be devoted to low-income tenants and abide by rent restrictions for a period of fifteen years. Rents are restrained to be no greater than 30% of "qualifying" income.

For the 1985 law rows, the rent stream is that which would allow the particular investor to break even without special tax preferences. The first two columns are based on the dynamic model; the third and fourth are based on the initial investor model. A comparison of columns shows how initial investor models tend to underestimate the capitalized value of tax incentives for subsequent investors since sale price is set exogenously. For the TRA86 columns, rents with the low-income housing credit are assumed to be limited to 30% of qualifying income, adjusted annually by the rate of inflation. For the credit for existing housing (4%), it is assumed that rents and all parameters for the initial investor are the same as in the low-income housing base case in row 2. The subsequent investors face limited rents and the same tax provisions as in TRA86.

Table 11.5 shows that before the Tax Reform Act of 1986, tax-exempt bonds were a very valuable subsidy.[20] While greatly accelerated depreciation would have been worth $3,267 over the life of the project under the assumed parameters, tax-exempt bonds would have been worth more than twice as much ($7,632) assuming that each owner received new tax-exempt bond financing.[21] If the unit qualified for low-income accelerated depreciation, the present value of tax benefits and appreciation in property value increased to $12,672. With the lower interest rates, the optimizing investor would have found it worthwhile to sell after only 10 years, despite recapture penalties, to another investor who could claim the interest rate subsidy on the inflated value of the property. If the low-income units had to be rented at below-market rents, some or all of the value of the tax subsidy would be lost to the investor.

Table 11.5 **Present Value of Low-Income Housing Tax Incentives Relative to 1985 Law**

	Dynamic Model		Initial Investor Model	
	Present Value	Holding Period	Present Value	Holding Period
1985 Law				
1. Baseline	$0	19	$0	19
2. Special depreciation	$3,267	13	$2,167	15
3. (2) + bonds	$12,672	10	$6,327	18
4. (1) + bonds	$7,632	14	$4,499	19
Tax Reform Act of 1986				
5. 4% credit	$15,558	15	--	--
6. 9% credit				
a. 20% low-income	$9,968	15	$8,508	15
b. 40% low-income	$15,790	15	$14,721	50
7. 4% credit + bonds				
a. 20% low-income	$1,129	15	$1,100	15
b. 40% low-income	$7,699	15	$7,422	50

Assumptions:

1. $50,000 unit, newly constructed; all owners subject to 19-year ACRS; no tax-exempt bond financing. Rent stream is the same for (1) to (4). See Table 11.8 for parameter list.
2. Same unit as in (1). All owners subject to 15-year ACRS. Original owner expenses contruction period interest and taxes.
3. Same as (2), but all owners receive tax-exempt bond financing at interest rate 20% below rate in (1) and (2).
4. Same as (1), but all owners receive tax-exempt bond financing.
5. Same as (3) for first owner, but subsequent owners receive the 4% per annum low-income housing credit and are subject to TRA86 depreciation rules. Rent for second and subsequent owners is constrained to be not greater than $3,600 (approximately 30% of 50% of 1986 median income) in 1986 dollars.
6. First owner receives 9% per annum low-income housing credit; subsequent owners receive 4% credit. All investors in (6) and (7) are subject to TRA86 depreciation rules. In (a), at least 20% of units have tenants with incomes not greater than 50% of area median income; rent is constrained to be not greater than $3,600 per year in 1986 dollars. In (b), at least 40% of units have tenants with incomes not greater than 60% of area median income; rent is constrained to be not greater than $4,320 per year in 1986 dollars.
7. First owner receives 4% per annum low-income housing credit and tax-exempt bond financing; subsequent owners receive 4% credit, but not bond financing. Otherwise, this is the same as (6).

This probably explains why most units financed with tax-exempt bonds were not claiming low-income depreciation, which had far tighter restrictions on tenants' incomes.

The difference between the "dynamic" columns and the "initial investor" columns represents the extent to which future tax subsidies might be capitalized into the value of the property. In rows 2 to 4, the present value of tax subsidies is increased by at least half because future owners would bid more based on anticipated tax benefits.

Rows 5 to 7 in Table 11.5 represent the values of some of the tax subsidies for low-income housing in the Tax Reform Act of 1986. Row 5 shows the value of the 4% per annum credit for existing low-income housing applied to the ACRS low-income project in row 3.[22] The present value of $15,558 indicates that the 4% credit is more generous to the hypothetical investor than prior law.

The other rows show the two credits available for newly constructed low-income rental housing. Row 6 shows that the 9% per annum credit (for 10 years) could be worth between $9,968 and $15,790 to an investor in present value terms. In other words, the credits are equal to or more valuable than any tax preferences under pre-TRA86 law. From the table, it seems clear that the investor would be far better off using the higher qualifying percentage (40% low-income tenants) because that would allow him to charge 20% higher rents. However, this analysis does not account for possibly higher costs caused by having a larger percentage of low-income tenants.

Finally, the last rows illustrate the value of tax-exempt bond financing plus the 4% credit. After TRA86, units financed with tax-exempt bonds will be subject to meaningful restrictions on tenants' incomes combined with limits on rents. This will tend to reduce the value of the bond-credit combination as a subsidy for new construction–to $7,699 assuming a qualifying percentage of low-income occupants of 40%. Nonetheless, this is still comparable in value to the most popular tax-exempt financing option before TRA86.

V. LIMITATIONS OF PROJECT MODEL ANALYSIS

The basic limitation of project model analysis is that the results apply specifically to a single project. Sometimes a particular kind of result seems to occur even when assumed parameters are altered over a range of values, as in the first two examples in the last section. In this case, it may be safe to generalize the qualitative result as a market-wide phenomenon. But project models are not models of markets. Great caution must be exercised in trying to infer anything specific about prices and quantities of rental housing in either the short or the long run based on project model analysis alone.

A particular problem arises in using rental project models to predict changes in market rents. This interpretation of model results is, even under the best of circumstances, totally dependent on a set of assumptions that are guaranteed to be false. There is an obvious problem that complicated rental project models are dependent on a large number of parameters. The results shown in Table 11.3[23] amply demonstrate that quantitative model results are very sensitive to reasonable changes in parameter values. However, more fundamentally, the assumptions that would be necessary to allow generalization of the optimal investment decisions for one representative investor to the rental housing market could simply not hold in practice, no matter how good the parameter values were.

An analogy may be drawn with the corporate income tax. Arnold Harberger's (1962) analysis showed that, in general equilibrium, the incidence of the corporate income tax may fall in whole or in part on any of the input factors as well as on consumers. In the last decade, a number of economists have reconsidered the incidence of the corporate tax in a variety of general equilibrium models. The general conclusion of these models is that the corporate tax is a tax on capital. (See Shoven and Whalley, 1984.) And yet, those who use rental project models to predict market rent responses are implicitly assuming that the entire incidence of taxes on rental housing capital falls on consumers, at least in the long run. This incidence assumption is no more credible in the rental market than it would be for corporations.

To be sure, other kinds of analyses depend heavily on implicit assumptions. Bradford and Fullerton (1981) pointed out that effective tax rate calculations are sensitive to the assumed relationship between nominal interest rates and inflation (typically Fisher's Law or some variant). Hendershott and Ling's (1984) conclusion that high inflation reduces churning depends heavily on their assumptions that real after-tax interest rates are constant (what Bradford and Fullerton refer to as "modified Fisher's Law") and that refinancing is costless. If, on the other hand, pre-tax interest rates are sticky and refinancing is costly, high inflation will reduce real interest rates. However, with high refinancing costs investors' debt-equity ratios will increase even as the cost of debt falls. In this case, inflation would tend to increase churning because the property is worth more to a purchaser at a high loan-to-value ratio and a low interest rate than to the seller if he holds. Thus, user costs could move in the opposite direction to that predicted by Hendershott and Ling assuming constant real interest rates.

A. USING RENTAL PROJECT MODELS TO PREDICT RENT CHANGES

Perhaps the most common use to which rental project model analysis has been applied is the prediction of the effect of tax policy changes on market rents. While a plausible argument can be made that the user cost estimate could represent long-run equilibrium rents in a simple microeconomic model, we believe that in practice this insight is likely to be of little relevance to estimating quantitative changes in rents. Generalizing rental project model results to infer the response of market rents requires a number of assumptions that have not been critically appraised in the literature. This section explores the implications of each of these assumptions.

1. A Model in Which User Costs are Long-Run Equilibrium Market Rents

To see which assumptions are important, we can construct a hypothetical economy in which user costs would be good predictors of long-run required rents. This economy consists of a large number of identical investors. There are no barriers to entry or exit from the rental housing market, so when rents exceed their break-even levels, new rental housing is constructed which drives rents down to the level of user costs. Similarly, when rents are too low, the quantity of rental housing declines until rents cover costs. In other words, the market for rental housing is perfectly competitive.

The model treats all input prices as exogenous. This is equivalent to assuming that the supply of inputs, such as land, is perfectly elastic in the long run. Furthermore, rental housing services are produced under conditions of constant returns to scale.

Analysts typically compare "equilibrium" states in which a particular tax policy is assumed to hold for the life of the project. So in our hypothetical economy, the tax policy and economic environment that is assumed to be the baseline has been in place or predictable for long enough that investors could adjust. The new tax policy is a permanent change in the tax system, or investors will believe that it is permanent for long enough that the market will achieve the new equilibrium.

Finally, there is an issue of how investors would discount future returns. In the simple world hypothesized here, prices are either constant or evolve in such a way that investors can rationally plan for the future. Predictability is necessary for the market to converge to an equilibrium.[24] This means that real discount rates should be equal to the investors' real after-tax cost of funds. If future prices, costs, and taxes are random and investors are risk-averse, then we assume that investors discount future streams at the interest rate that would be charged in the market on an investment of comparable risk.

2. Critical Assumptions

Of course, the real world is different from the stylized model presented above. But it is not obvious that these deviations are more problematic than those required to generalize the results of other kinds of simulation models. However, we will show that the following implicit assumptions underlying project model analysis tend to bias rent predictions, generally in the direction of overstatement of market rent changes.

- Either all investors are the same, or there is one class of investor that is the marginal investor, or there exists an average or representative investor whose behavior approximates that of the market. Under the marginal or representative investor model, the marginal investor before the parameter change will remain the marginal investor after the change.

- Either the supply for rental housing is perfectly elastic or demand is perfectly inelastic in the long run.
- The market is in long-run equilibrium before the change that is being considered is undertaken.
- Investors are myopic with respect to future policy or structural changes.
- The parameter values chosen are correct for the representative investor.

3. Is There a Marginal or Representative Investor?

Housing analysts often assume that a particular kind of investor (such as the tax shelter syndicate) is the marginal investor. Under this assumption, for small changes, considering the behavior of the marginal investor would be sufficient to determine what will happen to the market.

There are a number of reasons why this assumption is inappropriate. The real shortcoming of generalizing based on the "representative" investor is that there is no such animal, not even as an approximation. Refer again to Table 11.3, which compares investors in different marginal tax brackets. Residential rental real estate, with the possible exception of high-end units, is owned by significant numbers of individuals in each tax bracket, as well as by corporations and by government. See Gravelle, 1985.

As Table 11.3 indicates, variation in marginal tax rates differentiates investors' costs and optimal behavior in every significant respect. Thus we cannot assume that investors are identical.

An alternative rationale is that there is a class of investors who are or who represent the marginal investor; that is, the source of new investment in real estate. There are three problems with this interpretation. First, economic theory suggests that all investors are "marginal" investors in the sense that they balance their portfolios so that, on a risk-adjusted basis, the expected marginal opportunity cost of additional investment in real estate just equals the expected additional revenue.[25] Since all investors are on the margin, a change in prices should affect investors in all classes. It is possible that because of credit constraints and transaction costs, most investors would not adjust their portfolios in response to small changes in prices. However, this should hold for investors in all classes.

Second, analysts often model the marginal investor as an individual or syndicate that is using real estate as a tax shelter. Tax shelter syndicates only represent a minority of investors in the residential real estate market. Furthermore, this application of "marginal" is somewhat peculiar in that the tax shelters seem to be the least-cost, rather than the highest-cost, investors in the market. Tax deductions are most valuable to high-bracket investors. But traditional economic analysis would identify the highest-cost investor as the marginal investor.

Alternatively, analysts could assume that there is some average or representative investor whose behavior accurately reflects the behavior of the market. A logical choice would be to use an investor with the weighted average characteristics of all investors. However. Table 11.3A makes it clear that an average investor would not match the "market average" response of high and low tax investors to a policy or structural change.

For example, suppose that 44% of the investors are non-taxable and 56% are in the 50% tax bracket. The average tax rate is 28%. Based on Table 11.4A, the average user cost would be 9.29%. the average holding period would be 32.6 years, the average debt-equity ratio would be 0.54, and the average effective net tax rate on the investment would be 8.3%. But looking at the "average" investor with a tax rate of 28%, the user cost is 9.94%[26], the holding period is 19 years, the debt-equity ratio is 0.62, and the effective net tax rate is 24%. The debt-equity ratio and the holding period are not even continuous functions of the tax rate. It is clear that the "typical" investor would not match market aggregates very closely at all.

The third criticism of this approach is that tax policy changes rarely represent marginal change, even approximately. Every tax bill since 1978 has made significant changes in the way real estate was taxed. The Economic Recovery Tax Act of 1981 expanded opportunities for real estate tax shelters, and the composition of the market changed in response. The Tax Reform Act of 1986 generally discourages tax shelters. It would be naive to assume that there would not be a structural change in the market.

Comparing Tables 11.3A and 11.3B. the user costs for investors in different tax brackets flip-flop based on the assumed parameterization of the effect of tax reform. High tax bracket investors are the low-cost investors in the pre-1986 environment, and costs increase as the marginal tax rate falls. But after tax reform, low tax-bracket investors face the lowest costs and high tax-bracket investors become the high-cost investors, although by a small margin. As Tables 11.4A and 11.4B showed, investors subject to the passive loss limitation will face much higher costs than other investors after TRA86. The result should be a shift in rental investment away from tax-shelter partnerships in favor of tax-exempt institutions and other lightly-taxed investors.

We conclude that any analysis based on a representative investor is likely to exaggerate predicted rent changes, even if all of the other assumptions underlying rental project model analysis were correct. Actual market responses depend on the market dynamics, as investors in different classes become more or less important. While rental project model analysis might be a useful first stage in such an analysis, dynamic market analysis with many classes of investors is beyond the scope of available project models.

4. Problems With a Static Competitive Model Assuming Regressive Expectations

a. Is Supply Perfectly Elastic or Demand Perfectly Inelastic?

Rental project model estimates of market rents require, at a minimum, that either long-run supply be perfectly elastic or that long-run demand be perfectly inelastic. Figures 11.3A and 11.3B show these cases. Suppose, for example, that the initial equilibrium rent or user cost is P_o and that the equilibrium market quantity of rental housing is Q_o. Then a tax policy change raises the after-tax user cost to P_1 given the same input prices.

If input prices do not depend on the quantity of rental housing, then the long-run supply will be perfectly elastic as in Figure 11.3A. If demand is not perfectly inelastic, the equilibrium quantity of rental housing will fall until market rents rise by the full amount of the increase in user costs. However, it does not seem reasonable to assume that input prices are fixed in the long run. Since land of a given quality and location is fixed, even in the long run, land prices will depend on the quantity of rental housing. As individuals respond to higher rents by renting smaller homes, the demand for the complementary good, land, will also decline. Even for those who switch tenure modes to owner-occupancy, their housing costs will increase and they will tend to consume less housing. Furthermore, zoning laws may limit the convertibility of land between uses. Thus, overall demand for residential land will decline, which will drive its price down. The result is that the long run supply of rental housing can not be totally elastic.

However, if the demand for rental housing is perfectly inelastic, rents would also increase by the change in user costs, as Figure 11.3B shows. In this case, the quantity of rental housing remains fixed.

While empirical evidence suggests that demand for rental housing is inelastic (see Mayo, 1981), there is no statistical evidence that the demand elasticity is zero. In the long run, market demand reflects changes in tenure choice as the relative price of rental housing increases relative to owner-occupied housing as well as a decrease in average quantity of housing services consumed by those who continue to rent. Furthermore, long-run demand elasticities will be greater than in the short run when housing choices are limited by transaction costs of moving.

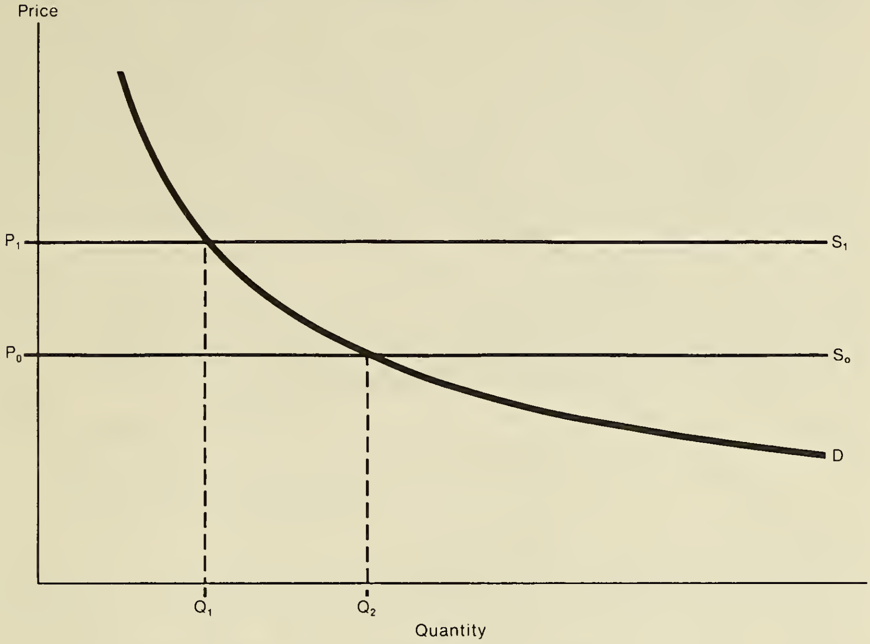
Figure 11.3C shows the equilibrium in the case where long-run supply and demand both have constant elasticities of 0.5. The graph shows that a parallel shift in the supply curve would increase equilibrium prices by less than half of the predicted change in the extreme models. While the actual level of price increase depends on long-run elasticities, it is unlikely that the long-run change in market equilibrium rents will be as great as the change in user costs.

b. The Relevance of Static Analysis

Even if one of the extreme models of long run supply and demand were accurate, that would not mean that the change in long run equilibrium rents would be a good predictor of how actual market rents would change, either in the short or the long run. If the user cost were an accurate measure of long-run rents, it would generally not represent rents in the short run. The high

Figure 11.3 **Long-Run Supply and Demand**

A. **Assuming Perfectly Elastic Supply**



B. **Assuming Perfectly Inelastic Demand**

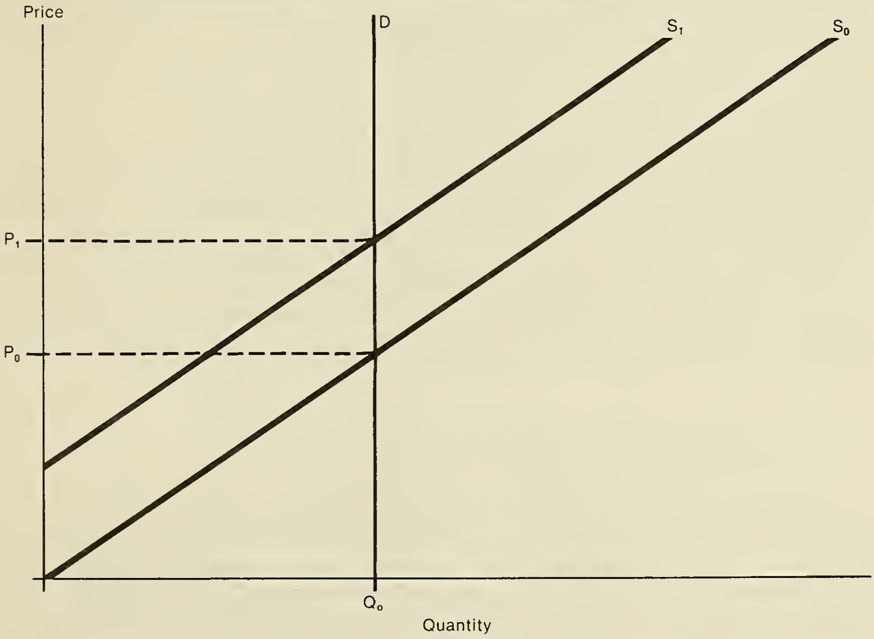
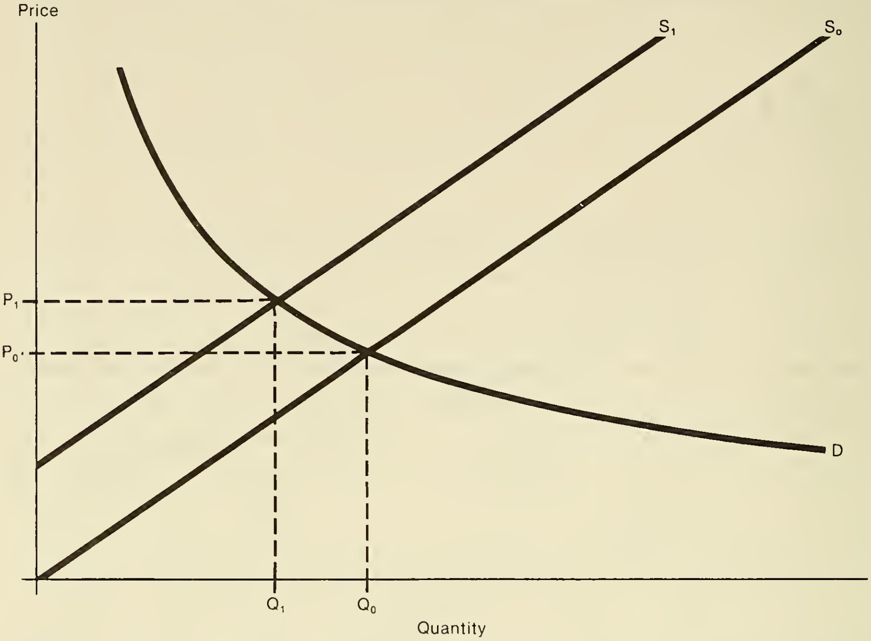


Figure 11.3 (continued)

C. **Assuming Constant Elasticity Supply and Demand**



transaction costs of buying and selling rental housing, the lengthy construction period for new housing, and local rent controls mean that market rents would be very slow to adjust toward their long-run levels. This also means that in a dynamic environment where tax and non-tax shocks are common, current rents are not at equilibrium levels.

Thus, the percentage change in long-run equilibrium rents as a result of adopting some policy could overstate or understate the actual change in rents, even if the model were perfectly specified. For example, several analysts predicted that equilibrium rents would increase from 1985 levels as a result of tax reform. But if rents in 1985 were above their equilibrium levels because of slow adjustment to the tax incentives in ERTA and the precipitous drop in interest rates of the past few years, the actual increase in equilibrium rents from their 1985 levels would be much less than predicted (or even negative).

c. Are Investors Really Myopic?

The assumption of myopia is also troublesome in trying to infer market rent changes from rental project models. Tax laws have changed about every two years over the last decade, and every new law has changed the depreciation treatment of rental housing. Rational investors would have to conclude that special tax incentives for rental housing are risky. Since tax benefits are capitalized into property values, investors should also be able to figure out that the resale values for their properties are also risky.

With pre-TRA86 depreciation deductions greatly in excess of economic depreciation, investors might have perceived more downside risk in resale prices than on the upside. The result would be that pre-TRA86 prices would not be as low as would be predicted by a model assuming perfect certainty. Thus, post-1986 price increases would be overstated by the model. This would be exacerbated if current investors expected that future tax bills would have a high probability of restoring tax shelter benefits, as has been suggested by some press reports. Finally, as Hendershott, Ling, and Follain (1986) pointed out, investors would have anticipated, at least in part, the effect of TRA86 on rental real estate, and prices would have begun to adjust long before the bill became law.

While it is common to account for risk through higher or lower discount rates, a model of how particular kinds of risk are reflected in market risk premia is really needed. This is a notable shortcoming of rental project models.

B. SENSITIVITY OF MODEL RESULTS TO PARAMETER CHANGES

Every model is dependent on assumed parameters. A useful feature of sophisticated rental project models is the large range of parameters that may be selected and varied. However, model results are very sensitive to the assumed parameter values. Thus, even if all of the other assumptions used to justify generalizing model results were valid, model predictions would be very imprecise.

1. Some Alternative Assumptions

Table 11.6 shows user costs based on tax parameters representing pre-TRA86 law and TRA86 for a particular investor under a range of assumptions. The discount rate is probably the most commonly varied assumption, and it is very important. Raising the real after-tax discount rate from 4% to 12% exaggerates the effect of tax reform on user costs. The user cost increase (what some call a rent increase) as a result of TRA86 is 49.4% greater at the high discount rate than at the lower one. Furthermore, while tax reform would still reduce churning at the higher discount rate, it would no longer be expected to end churning altogether.

Hendershott and Ling (1985) showed how inflation can affect investor behavior and user costs. Higher inflation (holding real rates of return constant) lengthens optimal holding periods and raises user costs, as is shown in row 3 of Table 11.6. If we assume that Fisher's law does not hold with respect to real after-tax interest rates, however, so that real rates of return decline as inflation increases, the results change substantially. Investors then would find it profitable to churn more often under pre-1986

Table 11.6 User Cost Estimates Under a Range of Parameter Values

	Pre-1986		TRA86		
	User Cost	Holding Period	User Cost	Holding Period	% Change in User Cost
1. Baseline	9.23%	19	10.02%	50	8.3%
2. High Discount Rate	12.23%	12	13.41%	18	9.8%
3. High Inflation w/ const. real interest rate	9.79%	14	10.54%	50	7.1%
4. High Inflation w/ lower real interest rate	6.52%	14	7.35%	50	13.8%
5. Constant Refinancing	8.91%	50	9.95%	50	11.8%
6. Retired Landlord (X)	10.27%	50	9.68%	50	-5.8%
7. Pure Tax Shelter (Y)	10.37%	4	16.40%	25	58.1%

Assumptions:

1. See Table 11.8.
2. Discount rate = 12%
3. Inflation rates for land, operating costs, and rent are 10%. Real after-tax interest rates are the same as in (1), 4%.
4. Same as (3), except real after-tax interest rates fall by half of the increase in inflation (2.5%).
5. Mortgages are costlessly refinanced each year to keep the loan-to-value ratio at 80%.
6. Discount rate = 2%, inflation rate = 3%, tax rate = 15%, interest rate falls from 12% before to 10.5% after TRA86, no capital gains tax (property is held until death).
7. Discount rate = 12%, inflation rate = 10%, tax rates at maximum level, interest rate = 18.57% with no reduction after TRA86, 10% syndication fee, passive loss limitation is binding after TRA86.

law. The real cost of debt falls and the debt-equity ratio declines rapidly with high inflation, so investors sell to others who can leverage the property. As a result, user costs are much lower than they would be in the absence of inflation. While the level of increase in user costs is only slightly greater than in the base case, the predicted percentage increase rises substantially, as shown on row 4.

The churning result with inflation and a decrease in real rates depends heavily on another assumption, that refinancing is prohibitively expensive. If refinancing is allowed continuously, as Hendershott and Ling assumed, then there is no incentive to churn under this scenario. With constant refinancing, user costs are lower under each tax law, and the expected increase in user costs rises by 32%.

Table 11.3 showed that the results are sensitive with respect to tax rates. Other assumptions are also important. The cautionary tale is that predicted user cost increases and behavioral responses depend heavily on assumptions, upon which reputable analysts may have wide disagreements.

2. Two Views of TRA86

Rows 6 and 7 of Table 11.6 show two views of the effect of tax reform on rents. Row 6 shows an investor, X, who will be pleased with tax reform. Her required rent, as indicated by the user cost, falls by 5.8% from pre-1986 law as a result of tax reform provisions. In contrast, row 7 shows an unhappy person, Y, who would require higher rents after 1986 than he would have in 1985 to earn the same after-tax rate of return. Were the market made up entirely of investors like Y, both before and after tax-reform, rents might rise as predicted by some housing industry analysts.

Individual X might be representative of a number of current owners of rental real estate. For example, a large number of small units are owned by individuals in low tax brackets (for example, retired persons). It might also be assumed that low tax bracket investors have a low opportunity cost of funds and thus a low real discount rate. These individuals got negligible benefit from accelerated depreciation and other front-loaded tax incentives under pre-1986 law. Since we assume in Table 11.6 that tax reform will reduce interest rates by 0.75 percentage points, the benefit to X of lower interest rates exceeds the value of her lost tax benefits.

For Y, on the other hand, tax preferences were very valuable under pre-1986 law. Y might represent a typical partner in a tax-shelter syndicate. By making a highly leveraged investment and taking advantage of accelerated depreciation, he could generate tax losses that were very valuable at a tax rate of 50%. The front-loading of tax benefits was especially important to this investor because he has a high discount rate. Longer depreciation schedules, lower tax rates, a higher tax rate on capital gains, and the passive loss limitation combine to raise his user cost by 58.1%.

These views of the effect of tax reform on rents are completely contradictory and, of course, completely wrong, except as they pertain to particular kinds of individuals. The user cost changes could not both represent average rent changes. The only information about rents that might be gleaned from these polar cases is that the actual long-run rent change would probably be no greater than Y's user cost increase and no less than X's. This is not terribly useful given the range.

However, the comparison is informative if we forget about market rents and think about the individuals. The example for X suggests that low-taxed and untaxed investors similar to X should become more important in the rental housing market after tax reform than they have been recently. Y's experience suggests that rental housing tax shelters will probably not be as viable after tax reform unless they change their structure. This, of course, was the point of the anti-tax shelter provisions.

C. THE TRACK RECORD OF RENTAL PROJECT MODELS

The previous section argued that the assumptions necessary to justify inferring market rents from rental project models are unlikely to be satisfied in practice. With the exception of the assumption that parameter values are accurate, the practical effect of the assumptions is that predicted rent swings tend to exaggerate actual market responses. There is no guarantee that the predicted change would have the right sign, even if parameters were right on average.

Table 11.7 shows how user cost estimates, adjusted for changes in construction costs, tracked market rents as measured by the consumer price index for rents over the 1975-1985 period. Figure 11.4 illustrates the relationship graphically. The figure suggests that predicted rent changes bear only a weak relationship, if any, to short-term rent changes.[27]

Compared to actual rents there are large swings in the adjusted user cost variable. Actual rents increased steadily between 1975 and 1985, but never by more than 9% or by less than 5% in a year. User costs, on the other hand, decreased in four out of ten years. The absolute magnitude of the annual changes was greater than 9% in five out of ten years.[28] Finally, the predicted increase in rents over the eleven years was more than double the actual increase.

This does not demonstrate that rental project models cannot predict rents in the long-run. It may be that actual rents can be explained by a distributed lag on predicted user costs or that a different set of baseline assumptions would produce a stronger correlation. But the data suggest that, if there is a relationship between user cost estimates and actual rents, it may be too subtle to be useful.

Figure 11.4 **Predicted versus Actual Rents, 1975 - 1985**

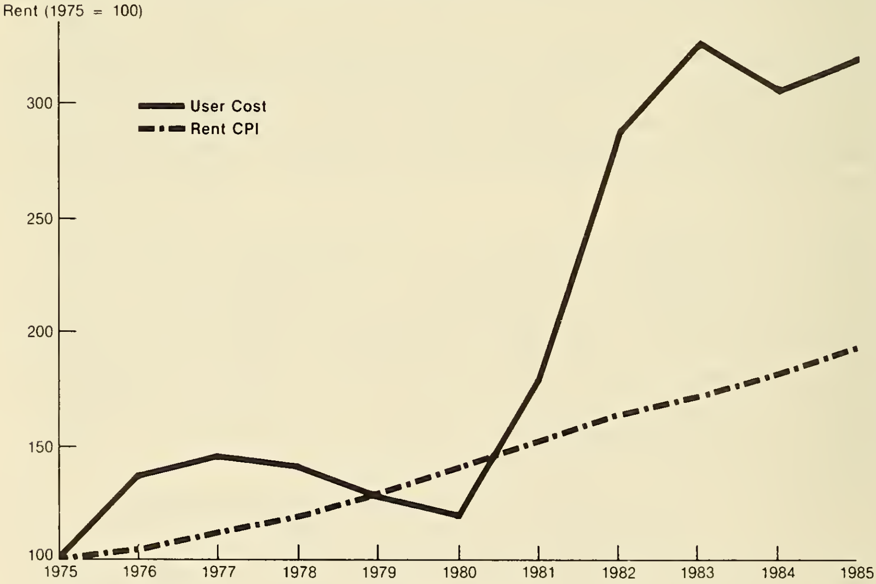


Table 11.7 **Project Model Estimates of Break-Even Rent Compared to the CPI for Urban Rents Using Historical Values - 1975 to 1985[a]**

	Inflation	Mortgage	Construction	Break-Even Rent[f]		CPI[g]		Holding
Year[b]	Rate[c]	Rate[d]	Cost[e]	Level	% Change	Level	% Change	Period
1975[1]	9.1%	9.00%	89	100	--	100	--	9
1976[1]	5.8	9.00	92	137	37%	105	5%	16
1977[1]	6.5	9.02	100	146	7	112	6	14
1978[2]	7.7	9.56	113	141	-3	119	7	9
1979[2]	11.3	10.78	129	127	-10	128	7	5
1980[2]	13.5	12.66	143	120	-6	140	9	4
1981[3]	10.4	14.70	152	178	48	152	9	7
1982[3]	6.1	15.14	154	287	61	163	8	15
1983[3]	3.2	12.57	157	326	14	173	6	50
1984[4]	4.3	12.38	164	307	-6	182	5	18
1985[5]	3.6	11.50[p]	169	320	4	193	6	19

[a] For non-low-income residential rental property.

[b] Tax law assumes marginal tax bracket of twice median income investor and:

[1] 175% declining balance (DB) depreciation new property, 125% on used property with useful life over 20 years, 50% capital gain exclusion, 10-year amortization of construction period interest and taxes.

[2] Same as a, except 60% capital gains exclusion.

[3] Same as b, except ACRS (175% DB), 15 year life on new and used property.

[4] Same as b, except ACRS, 18 year life.

[5] Same as b, except ACRS, 19 year life.

[c] Consumer price index for all items.

[d] New home mortgage yields (p = preliminary).

[e] Department of Commerce composite construction cost (1977 = 100).

[f] Product of user cost and construction cost index normalized so 1975 = 100.

[g] Normalized so 1975 = 100.

VI. CONCLUSION

This paper has described the state of the art of rental housing project models. We have found that rental project model analysis is useful—almost essential—in studying the behavioral responses of individual investors to complicated tax policy changes that may affect current or future investors in rental housing. Rental project models can be used to study how special tax preferences are capitalized into land and property values as well as the direct effects of those policies on the costs and returns to investors. The OTA rental project model provides estimates of effective tax rates that take account of the special characteristics of the rental investment, especially leveraging and the effects of tax benefits on future investors when there is churning.

However, rental project models cannot by themselves produce reliable estimates of changes in market rents as a result of tax policy changes. Virtually all of the assumptions necessary to generalize the results of rental project models to the market as a whole tend to predict grossly exaggerated market responses. No credible market analysis can rely solely on the predictions of rental project models.

We have used the OTA model to look at the effects of the Tax Reform Act of 1986 on the behavior of residential rental real estate investors. It was found that tax reform succeeds in greatly reducing the distortions in investor behavior that were prevalent under prior law.[29] TRA86 diminishes the incentive to churn real estate for tax reasons. It reduces the disparity in the costs and returns to real estate investment among different investors. As a result, residential real estate will no longer provide large tax shelters for high-income investors (except for low-income housing). Investors in all tax brackets will have to evaluate real estate investment based on the economic, rather than the tax, consequences. Further, we found that the most significant anti-tax shelter provisions in TRA86 were lengthening depreciation schedules and lowering marginal tax rates, not the passive loss limitation, even though the latter was the only explicitly tax shelter-oriented provision.

This paper has focused on using the OTA model as a residential rental housing project model, but the scope of such analysis is much broader. OTA analysts have used the model to study the effects of tax provisions and proposals on commercial real estate. The model could also be used to study the effects of taxes on other capital assets, especially long-lived assets for which resale markets are reasonably well developed.[30] Farm machinery and equipment, for example, would provide logical applications.

Several extensions of rental project model analysis would be worthwhile. The model presented here does not allow for rehabilitation, although tax laws are important in certain kinds of rehabilitation projects. A better developed model of the role of uncertainty in rental housing investment decisions is clearly called for. While Hendershott and Ling's approach of discounting future streams of income and expense at different rates is an interesting extension, a full treatment of risk would have to explicitly account for the nature of the random disturbances that could affect future income. A model that assumed that investors maximize expected utility under some degree of risk aversion might provide results very different from the essentially perfect certainty model presented here.

Finally, the question of how tax policy affects market rents is important, even if present models are not well suited to answering the question. A general equilibrium market model that incorporated the level of detail about tax policies in the OTA model would be a valuable tool. Such a model should include a variety of classes of investors and should integrate the various kinds of real estate: residential rental, commercial rental, and owner-occupied housing. Investors should choose between real estate and other kinds of capital investment. Consumers should choose between rental and owner-occupied housing as well as other consumer goods. However, whether such a model is or will be technically feasible is an open question.

APPENDIX

A. INTRODUCTION

The OTA Rental Housing Project Model program was developed by the Treasury Department to simulate the effects of tax law changes on returns to rental housing investment. The model simulates the costs, returns, and tax consequences of a hypothetical real estate investment. The model includes tax provisions for housing under current and recent Federal statutes, as well as several reform proposals made over the past few years.

An extensive set of data parameter assumptions is necessary to generate user costs, sales prices, and before and after tax returns for a hypothetical investment in a rental unit. The model requires specification of tax law parameters, the building's useful life. the mix of the original investment between land, structure, and construction period costs, interest rates and inflation rates, operating costs, competitive real rates of return and the marginal tax rates of current and potential future investors, and the economic rate of depreciation for the structure. All of these parameters may be changed by the model user.

The program output may include (depending on print parameter settings) detailed information about the initial investment and period-by-period before and after tax returns for the original and subsequent investors. By default, the calculator computes the present value and internal rate of return, both before and after tax, earned by the original investor. The program can also be set to find the initial rent-to-value ratio that would give the initial investor an after tax present value of zero or compute the internal rate of return that would make all investors break even in present value terms.

Table 11.8 lists the parameters used to simulate a rental housing investment both before and after enactment of the Tax Reform Act of 1986. The full list of possible parameters is much longer. Documentation is available upon request. For reference, Table 11.9 briefly summarizes the key rental housing provisions in the Tax Reform Act of 1986.

B. HOW THE CALCULATOR WORKS

The flowchart in Figure 11.5 illustrates how the model computes before and after tax returns for all investors in a rental project over its useful life. The calculator inputs parameter values from a FORTRAN NAMELIST.

The calculator can operate in several modes. In its basic mode, the calculator may be thought of as planning the optimal investment for a well-informed hypothetical investor. This investor would want to know how much the investment will cost (see 2 on Figure 11.5). the expected stream of rents and operating costs (3), the tax benefits that would accrue while the property is held (5), and sales prices and tax costs of sale at various dates (4 and 5). The investor could then find the holding period that maximized the present

Table 11.8 **Input Parameters and Baseline Values**

	1985 Law	TRA86
A. Economic Characteristics		
1. initial operating cost to value ratio	.0250	.0250
2. true depreciation rate	.0300	.0300
3. growth rate of prices		
a) land	.050	.050
b) structure	.050	.050
c) CPI.050	.050	
d) operating costs	.050	.050
4. length of construction period	1	1
5. amount spent on structure	44000.	44000.
6. value of land when building placed in service	6000.	6000.
7. fraction of expenditures on structure by year		
a) year 1	1.000	1.000
B. Financing Characteristics		
1. initial mortgage/value ratio	.800	.800
2. mortgage rate	.1200	.1125
3. initial mortgage term (years)	30	30
4. frequency of refinancing (years)		
a) original owner	NA	NA
b) subsequent owner	NA	NA
5. construction loan/value ratio	.800	.800
6. construction loan rate	.1200	.1125
C. Tax Characteristics		
1. income tax bracket of owner		
a) original owner	.40	.22
b) subsequent owner	.40	.22
2. tax bracket of lender	.25	.20
3. property tax rate	.018	.018
4. capital gains treatment		
a) structure		
1) inclusion rate	.40	1.00
2) if indexed	No	No
b) land		
1) inclusion rate	.40	1.00
2) if indexed	No	No
5. depreciation treatment		
a) schedule, ACRS		
1) if declining balance	No	No
2) useful life	19	27
3) whether indexed	No	No
4) type of recapture	Excess	None
6. CPIT treatment		
a) fraction expensed	.10	.00
b) fraction 10 year amortization	.90	.00
c) fraction capitalized	.00	1.00
d) if indexed	No	No
7. minimum tax		
a) rate	.00	.00
b) fraction of excess depreciation subject	.00	.00
c) fraction of excluded gains subject	1.00	1.00
8. tax-exempt financing		
a) whether tax-exempt financing	No	No
b) percent reduction from conventional rate	20.	20.

NA = Not applicable.

Table 11.9 COMPARISON OF REAL ESTATE TAX PROVISIONS BEFORE AND AFTER ENACTMENT OF THE TAX REFORM ACT OF 1986 (TRA86)

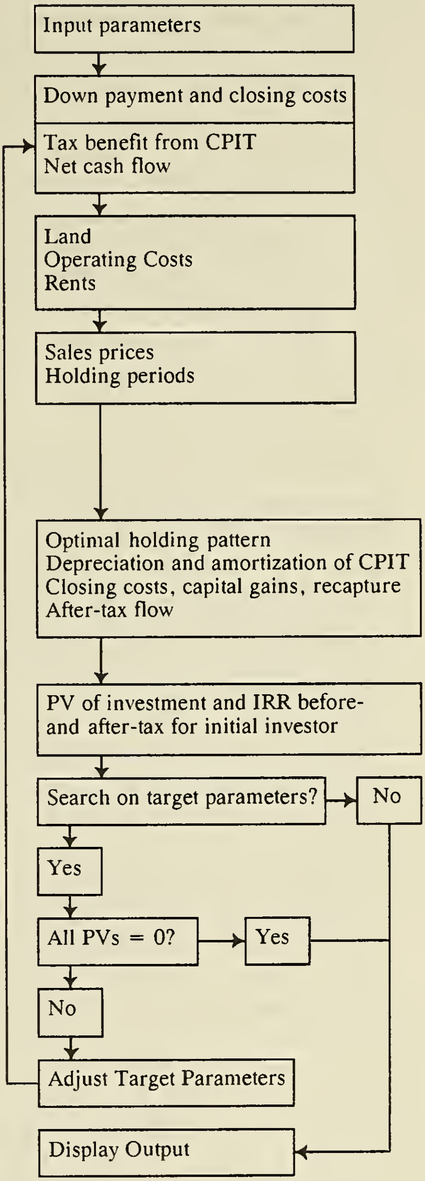
Item	1985 Law	TRA86
Depreciation		
Low Income*	15-year real property; 200% DB	27.5-year SL
Other	19-year real property; 175% DB	Residential: 27.5-year SL Commercial: 31.5-year SL
Recapture		
Low-income*	Excess over SL; phased-out: 1% per month after 100 months	Not relevant because there is no exclusion of capital gains
Other	Excess over SL	
Construction Period Interest and Taxes		
Low Income*	Expensed	Capitalized
Other Housing	10-year amortization	Capitalized
Rehabilitation Credit		
Historic Structures Reduction	25% tax credit; 1/2 reduces basis	20% tax credit; full basis reduction
Nonhistoric Structures (nonresidental)	15% credit for 30-year old, 20% credit for 40-year old; full basis reduction	10% credit for buildings placed in service before 1936.
Rapid Amortization		
Low Income* Rehabilitation	60-month amortization; $20,000 or $40,000 limit per unit	Provision allowed to expire 12/31/86
Low Income Housing Credits	No provision	
Credit Level		
Non-Federally Subsidized Units		Credits with present value of 70% of basis over 10 years for new construction and qualified rehabilitation expenditures
Federally Subsidized (e.g., tax-exempt bonds)		Credits with present value of 30% of basis over 10 years
Certain Existing Housing (HUD resyndications)		Same as Federally subsidized
Additional Low Income Units		Units added above the contracted level may receive credits at 2/3 the annual rate of base credits over the remaining years in the compliance period
Income Requirement		
General		Same as for tax-exempt bonds
Existing Housing		At least 50% of units are very low income*

Table 11.9 **COMPARISON OF REAL ESTATE TAX PROVISIONS (continued)**

Item	1985 Law	TRA86
Rent Limitation		Rent can be no greater than 30% of qualifying income (either 50% or 60% of area median)
Compliance Period		Income requirement and rent limitation must be met for 15 years
State Volume Cap		
Non-Federally Subsidized		New annual authority of $1.25 per resident per year, admin. by state housing authority
Federally Subsidized		Not subject to credit cap (although tax-exempt bond cap may apply)
Compliance Penalty		Accelerated portion of credit (relative to a 15 year credit) is recaptured with interest
Expiration Date		December 31, 1989
At-Risk Rules		
Deductibility of Losses	No limit for real estate	Repeal real estate exception, except 3rd-party non-recourse debt secured by real estate is considered at risk
Tax Exempt Bonds		
Multi-Family Rental	Unlimited tax-exempt bond authority	Bond authority subject to private-purpose bond state volume cap
Income Requirement	20% of households (15% in targeted areas) have incomes <80% of area median or 25% of households have incomes <70% of area median	Either 20% of units are very low income* or 40% are low income*
Qualified Project Period	Max {10 years, 50% of loan term, period of Section 8 Assistance}	Minimum period is 12 years
Compliance Penalty	Bonds retroactively taxable	Bonds retroactively taxable; interest not deductible
Loss Limitation	No provision	Rental losses may not be used to offset active income; $25,000 exception for active rental losses by indiv., phase-out at high incomes

*Definitions
  Low Income
    1985 Law - 85% of households have incomes ≤ 50% of area median, adjusted for family size
    TR86 - Incomes ≤ 60% of area median, adjusted for family size
  Very Low Income
    TRA86 - Incomes ≤ 50% of area median, adjusted for family size

Figure 11.5 **Flow Chart of Treasury Rental Investment Calculator**


Input parameters
Down payment and closing costs
Tax benefit from CPIT
Net cash flow
Land
Operating Costs
Rents
Sales prices
Holding periods
Optimal holding pattern
Depreciation and amortization of CPIT
Closing costs, capital gains, recapture
After-tax flow
PV of investment and IRR before- and after-tax for initial investor
Search on target parameters?
No
Yes
All PVs = 0?
Yes
No
Adjust Target Parameters
Display Output

1. Input Data
   NAMELIST input parameters override default values.

2. Initial Investment (period 0)
   Net cash flow = - down payment
   - closing costs
   + initial tax benefit from CPIT

3. Generate Flows
   Determined by initial values of land and structure, rent-to-value and operating cost-to-value ratios, and rates of inflation.

4. Generate Sales Prices and Holding Periods
   For a given year:
   1. Find the sales price for each possible holding period that gives a typical investor a competitive rate of return.
   2. The optimal holding period and sales price give maximum sales price in (1).

5. Compute the Consequences of Optimal Holding Pattern
   The optimal holding period for the orignal owner is computed as above, except that the purchase price is fixed and the tax benefits of CPIT are included and the original owner's tax rate is used.

6. Analysis of Investment (initial investor)
   Present value is based on initial cost, and taxes. IRR is found iteratively.

7. Optional Search
   Vary initial rent-to-value ratio or target internal rate of return until all PVs = 0 (i.e., everyone gets competitive rate of return).

   Done search?

   Marginal tax rates

8. Output
   For each investor:
   Initial costs (including CPIT for first)
   Pre-tax cash flow
   Cash-flow tax benefits
   After-tax cash flow
   Closing costs, capital gain taxes, recapture
   Either after-tax PV and IRR for first investor or IRR for all investors or user cost.

value of the investment. The property would be purchased if the net present value of the investment were at least zero.

Most real estate project models treat the sales price in each period as an exogenous stream (Hendershott and Ling, 1984, is the notable exception). The Treasury model computes the sales price in each period that would give a subsequent investor who behaves optimally the same rate of return as his/her best alternative investment (i.e., net present value equals zero). The calculator iterates over possible holding periods and finds the bid price for each holding period. The sales price in any period is equal to the highest bid price, which corresponds to the optimal holding period.

Computation of the optimal holding period requires knowledge of all future sales prices. At the terminal period (N), the structure is assumed to have totally deteriorated, so sales price would be equal to the value of the land. At period N-1, all future sales prices are known. The decision is whether to hold for one period or to sell the property for its land value. If the property is held, the sales price in period N-1 is the present value in period N-1 of cash flows in the last two periods. Working backwards, all future sales prices are thus always known. The calculator computes the sales price and holding period in each period by computing the optimal holding period for some sales price, then raising or lowering the sales price depending on whether the present value is positive or negative, and repeating the computation until the present value is driven to zero.

The alternative modes of operation. which are set by parameter, provide a way of altering some of the inherent assumptions in the basic mode computation. Using option 1, the initial rent-to-value ratio is varied until the initial investor's net present value is driven to zero. This provides a measure of the user cost of rental housing. In the second option, the calculator finds the change in the internal rate of return for all investors (i.e., the rate of return such that all earn a net present value of zero). This gives a measure of how changes in policy or other parameters would affect the return on capital assuming that the supply of capital is fixed and all other prices remain constant. After a tax increase, for example, the change in the internal rate of return would indicate how much interest rates would have to fall to make the hypothetical investor just as well off as before the tax. The internal rate of return also allows measurement of effective tax rates.

FOOTNOTES

[1] For example, some analysts predicted that residential rents would increase by more than twenty percent, while others predicted long-run rent increases of less than ten percent. For low-income housing, the disparity in estimates was much wider.

[2] This is arbitrary. In fact, because of the weak recapture provisions on low-income housing, investors would often find it profitable to sell before 15 years. See Table 11.5 for examples.

[3] Hendershott and Ling (1985) argue that different income and expense streams should have different discount rates depending on their relative certainty. Nonetheless, there is no empirical evidence showing some future streams to be more certain than others. Summers (1986) argues that business planners do not discount relatively sure streams of tax deductions at a lower rate than other riskier expenses and income.

[4] Unlike the internal rate of return, which may only be calculated iteratively, the equivalent coupon rate can be computed based on a simple formula.

The equivalent coupon rate is the value i that solves the equation,

$$\Sigma_{t=1}^{N} iY(1+\gamma)^{-t} + Y(1+\gamma)^{-N} = X ,$$

where N is the holding period of the investment (15 years in the example), Y is the initial investment ($5,150), γ is the discount rate (8%), and X is the gross present value of returns to the investment ($7,693). The equation simply requires that the "equivalent" bond, which pays rate i, pay annual interest (the first part of the equation) and repay the principal at the end of year N (the second part) with present value equal to the present value of returns to the rental investment (X).

[5] For example, the five percentage point drop in mortgage interest rates since 1981 almost certainly has had more effect on rents and returns to investors than any of the tax-shelter provision in the Tax Reform Act of 1986 will have, even under the most extreme assumptions about other parameter values.

[6] The holding period is also important in determining the rate of return to the investor, which will generally depend on when the project is sold.

[7] Endogenous determination of holding periods is the essential feature of timber, oil, and other resource models. In this kind of model, the analyst is interested in how long an investor will hold a tree (or oil well) before cutting (or drilling).

[8] The term churning refers to the frequent sale of an asset in order to maximize the value of tax benefits. The primary tax benefit to churning, at least before TRA86, was that new investors would get a "step-up in basis," while the seller would not be fully taxed on the gain due to weak recapture rules. In other words, each new purchaser would be able to take new accelerated depreciation deductions based on the purchase price of the asset, rather than the old depreciated basis.

[9] Hendershott and Ling (1985) independently developed a model similar to the one described here.

[10] Technical documentation and FORTRAN 77 source code for the model is available upon request.

[11] The user cost is the most common, and most commonly misinterpreted, output of rental project models. Section V discusses the misinterpretation of user costs in detail.

[12] Holding other parameters constant, model simulations indicate that pre-TRA86 investors in high tax brackets earned far higher rates of return than investors in low brackets.

[13] The model uses computed internal rates of return for r_a and r_b.

[14] See Musgrave and Musgrave, 1983, pp. 185-186.

[15] Recapture provisions penalized sale of the property before the end of the depreciation period (19 years in 1985) by subjecting capital gain which corresponded to deductions in excess of straight-line depreciation to taxation at ordinary rates rather than the lower capital gains rates.

[16] Table 11.9 compares the rental housing provisions in the Tax Reform Act of 1986 with those of pre-1986 law. TRA86 includes a new tax credit for low income housing, which may encourage churning if it is extended beyond its planned expiration date.

[17] The low-income housing credit provides a credit-equivalent of greatly accelerated depreciation with a harsh recapture provision during the first fifteen years after the credit begins. This credit will encourage churning of qualifying low-income properties every fifteen years. However, since the credit provision is temporary, the incentive to churn low-income housing will be sharply reduced if the credit is allowed to expire as scheduled in 1989.

[18] TRA86 may make effective tax rates quite different for individuals in the same tax bracket. For example, a high-income investor with sources of passive income will find investing in

loss-producing real estate more advantageous than a similar investor with portfolio and labor income only. Since investors with incomes below $200,000 will only be able to currently claim low-income housing credits equal to their marginal tax rate times $25,000, individuals in the top bracket (33%) will be able to claim the most credits.

[19] To qualify for the low-income housing credit, either 20% of rental units must be rented to households with incomes not greater than 50% of area median income or 40% of units must be rented to tenants with incomes not greater than 60% of area median income.

[20] The value of tax-exempt bond financing includes a possibility for leveraging the value of the subsidy. In the case of elderly housing, for example, the non-low-income units might well be rented to tenants who can pay market rents. The result is that with a 20% low-income occupancy requirement, the value of tax-exempt bond financing is leveraged by as much as four to one. In other words, since the bond financing is for the whole project, four non-low-income units are subsidized for every one low-income unit. However, in other cases, rents might be depressed or risk might be higher for the entire housing project, which would mean that the leveraging argument would be less valid. The table assumes no leveraging.

[21] To qualify for bond financing, subsequent owners would have to substantially rehabilitate the property, which was not reflected in the model runs. To the extent that rent increases would not cover the cost of rehabilitation, the value of future subsidies may be exaggerated.

[22] The low-income housing credit is scheduled to expire after 1989, many years before any ACRS low-income housing would become eligible (since a project has to have been in service for at least 15 years to qualify for the credit). The low-income housing credit examples in Table 11.5 answer the question: "how would investors value a property under TRA86 if they expected the low-income housing credit to be extended permanently?"

Note that there is no initial investor column in row (5) because the credit only applies to second and subsequent investors.

[23] See also Table 11.7, which is discussed in section C.

[24] Note that "predictability" does not mean that there can be no random shocks. A rational expectations equilibrium could exist if the optimizing behavior of economic agents conditional on their expectations produces market prices whose means are equal to those expectations. However, the rental project model would only produce user costs that represent market rents if investors were risk neutral and the investors' optimization problem satisfied the conditions for "certainty equivalence" (Sargent, 1987). Proof of certainty equivalence is beyond the scope of this paper.

[25] This issue is reminiscent of Miller's (1977) model of the effect of taxes on ownership of debt and equity and subsequent analyses. In Miller's model, there is some marginal tax rate at which an investor is indifferent between holding debt and equity. Investors with higher marginal tax rates hold only equity, and investors in lower tax brackets hold debt. In this framework, the marginal investor determines the relative cost of debt and equity in equilibrium.

Of course, as Miller noted, equity is held by non-taxable institutions and debt is held by high tax bracket investors. Subsequent general equilibrium models of portfolio choice under risk with many classes of investors have shown that portfolio diversification between debt and equity is rational. (See Slemrod, 1985, or Galper, Lucke, and Toder, 1987.) In a model with risk, every investor is a marginal investor, buying assets until marginal risk-adjusted after-tax rates of return are equalized. Thus, the simple device of considering a single investor or class of investor as the marginal actor is inappropriate.

[26] The average user cost would always be less than the user cost of the "average" investor, at least for the assumed pre-TRA86 parameters. Figure 11.2 shows that user costs were a concave function of marginal tax rates, which implies this result.

[27] The hypothesis of no relationship between adjusted user cost and rents is not rejected at the 5% level. The estimated regression equation is

$$\begin{array}{llllll} \text{CPI Rent} & = 0.819\ + & 0.0867 & \text{Time}\ + & 0.0432 & \text{User Cost.} \\ & \ (38.8) & (15.2) & & (2.1) & \end{array}$$

T-ratios are in parentheses. The adjusted R^2 with eight degrees of freedom is 0.993. However, if user cost is excluded, the adjusted R^2 is 0.990. Note that the small sample size and obvious collinearity between user cost and the trend variable make this a dubious statistical test. It suggests, however, that if user cost has any contemporaneous effect on rents, it is likely to be dwarfed in importance by other factors.

[28] To keep things in perspective, one should note that non-tax factors contributed significantly to predicted changes.

[29] This is not true in the case of low-income housing. However, presumably low-income housing tax preferences are designed to distort behavior.

[30] Note that a rental market is not absolutely necessary. The project model's "rents" are really imputed rents or the opportunity cost of capital.

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